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Behavioral and medical comorbidity: identifying challenges and transforming systems of care

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Factors affecting self-esteem and disease acceptance in patients from infertile couples

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Introduction: Infertility has been diagnosed in millions of people around the world and is described as a complex medical, mental, and social problem that affects many aspects of life. The aim of the study was to extract the determining factors and the level of self-esteem and the degree of acceptance of the disease in infertile patients and to find differences between women and men in this aspect.

Methods: A total 456 patients (235 women and 221 men) from infertile couples participated in a cross-sectional study. To collect data a Personal Information Form (PIF), Rosenberg Self-Esteem Scale (SES), and Acceptance of Illness Scale (AIS) were used.

Results: The overall self-esteem score for the whole sample was 30.50 (15 ± 30) points and for acceptance of the disease 32.4 (8 ± 40) points. In the study group, men obtained a slightly higher level of self-esteem than women (31.00 vs. 30.04 points). Additionally, men had a higher level of acceptance of the disease (33.12 vs. 31.80) than women. Socio-demographic factors such as age and level of education had impact on scores SES and AIS. Clinical factors did not determine the results of SES and AIS, both in the overall sample and in the female and male groups.

Conclusion: Self-esteem in patients from infertile couples increases with age and level of education. There are also significant differences between women and men, i.e., positive correlations between the level of education and self-esteem in men and the degree of acceptance of the disease in women.

KEYWORDS

infertility, self-esteem, disease acceptance, SES, AIS

1. Introduction

Infertility was described by World Health Organization (WHO) as a disease of male or female reproductive system defined by an inability to achieve a clinical pregnancy after 12 months of regular sexual intercourse without using contraception. A couple is considered infertile if they have been diagnosed with infertility as defined by the WHO. Infertility should not be misunderstood with sterility. Sterility is inability to naturally conceive and produce a live child by a couple (1). Estimated data shows that that this issue concerns 186 million individuals worldwide (2). Polish Society of Reproductive Medicine and Embryology (PSRME) and the Polish Society of Gynecologists and Obstetricians (PSGO) estimated data confirms that in Poland the problem with fertility affects about 1 million couples (3, 4).

The difficult situation faced by infertile couple results in the failure to meet one of the basic needs of most people, that of having children. Being a parent is an individual desire, but also a social expectation. Infertility from a social perspective is the inability to achieve the desired social role of parenthood, which is why it is often associated with psychological stress (5).

In modern societies, parenthood is postponed until later, and most people assume that they can become parents when they decide to do so (6, 7). Therefore, the problem of conceiving a child and the diagnosis of "infertility" is usually a big shock for the couple, this is associated with an uncertain prognosis and is a source of stress that can impact the wellbeing of people with fertility disorders (8–15).

Diagnosing and treating infertility is fraught and takes a long time with a relatively low success rate (about 20–40%) (16), which is also a source of stress and frustration (16–19). It is confirmed that there are gender differences between women and men in the approach to diagnosis together with the treatment of infertility. The women are more exposed during treatment and report stronger reactions both to infertility and treatment overall (20). For this reason, infertile women are more burdened by infertility stress and had stronger emotional reactions to infertility when compared to the men (21).

According to literature, infertility studies predominantly focus on women (22, 23). Many authors also confirm that there are differences between women and men and types of concerns in areas such as physical health, mental health, relationship satisfaction and satisfaction with sex life, social stigma or attitudes toward illness. Many studies have shown that women generally have less tolerance for accepting infertility in relationships. General health problems are more common in infertile women than men (24). With regards to mental health, women also had higher levels of stress (25, 26) and higher severity of depressive symptoms than men from infertile couples (27–29). Men in infertile couples had greater feeling of satisfaction from relationship and greater satisfaction with sexual life than woman (25, 30). There are also communication differences between men and women in infertile relationships. Women are more open to talking about infertility, and they more frequently address this topic with their partners, friends and family. Men, on the other hand, are reluctant to talk about infertility and tend to limit conversations to their partner or medical staff. Regardless of this, partners are the greatest support for each other in this situation (31, 32). It was also confirmed that infertile couples often experience social stigma and this issue is more likely to affect women (24, 33–35). In women, self-stigma also occurs, and this has bad impact on their psychosocial functioning and self-esteem (36). Other sources confirm that men are usually more optimistic than women in the situation of infertility (27, 32).

The experience of infertility affects many aspects of life and leads to a crisis for many couples (8, 37). Knowing that it is impossible to have a child initially means emotional shock, sadness and disappointment for the couple (32). This situation often leads to a sense of frustration, self-criticism, guilt, a decrease in self-esteem (38–42), which makes it difficult to accept the situation and come to terms with the diagnosis. In our work, we focus on determining the level of self-esteem and acceptance of the disease in infertile patients.

Self-esteem is a kind of general self-evaluation. According to Rosenberg, self-esteem is a positive or negative attitude toward oneself and a general evaluation of one's own thoughts and feelings in relation to oneself (43). Self-esteem is an indicator of well-being because it has a positive relationship with mental health, social adjustment, and quality of life (44–46).

Self-esteem can change both in the short- and long-term perspective and depends on different events and situations in life (47), e.g., Cox et al. pointed out that self-esteem in women increases after successful infertility treatment (48). Long-term infertility is usually associated with the occurrence of negative emotions and psychological consequences, such as chronic stress and anxiety (49). Many authors confirm self-esteem is lower in infertile men and women, comparing to a healthy population (39–41).

In our study we tried to also identify acceptance of the disease, what should be understood as the absence of problems with adaptation to the limitations resulting from the disease, a sense of independence and self-sufficiency, and unreduced self-esteem (50, 51). Patients who accept their illness are more optimistic and hopeful, they have more trust in the proposed treatment, and they also more actively take part in the therapy (52). The level of acceptance of the disease depends on the nature of the disease and the discomfort it creates, as well as on socio-demographic conditions (50, 51). The acceptance of the disease in the case of infertility varies and depends on gender, prognosis (52) and the scale of social support and the economic situation of the population (49).

As Dembinska mentioned the acceptance of one's own infertility is much less often described in the literature compared to other chronic diseases (50). To our knowledge in Poland there has only been one study on self-esteem and the level of acceptance of the disease and concerned only infertile women. Our study covers both sexes and was designed to establish the factors determining the level of self-esteem and the degree of acceptance of infertility in patients from infertile couples and to find differences between women and men in this aspect.

2. Materials and methods

2.1. Participants and course of the study

Quantitative, non-experimental method of empirical research was used. It was a cross sectional study. After obtaining permission from medical facilities and the ethical commission 500 patients were invited to take part who met the conditions for inclusion to the study. Detailed criteria inclusion/exclusion are presented in Table 1. The estimate data for Poland was considered to calculate the estimate data (approx. 1 milion couples). The sample size was calculated using the G*Power 3.1.9.2 program (Faul, F., Erdfelder, E., Lang, A.-G., Buchner, A.,

TABLE 1 The main eligibility criteria for study group.

Inclusion criteria	Exclusion criteria
Confirmed diagnosis infertility in couple	Couples without confirmed diagnosis of infertility
Age ≥ 18 years old	Age < 18 years old
No communication problems and the ability to understand and fill in the questionnaire	Communication problems and lack of ability to understand and fill in the questionnaire
Voluntary consent to participate in the study	Lack of consent to participate in the study

Düsseldorf, Germany). The minimum sample size was 383. Total 456 men and women from infertile couples took part in our study.

The research was conducted in three medical facilities offering infertility treatment in south-eastern Poland. Before conducting the project, we got a written permission from all medical facilities and from a relevant ethical committee. Patients who had previously been diagnosed by a gynecologist with infertility in a couple were informed about the possibility of taking part in a survey by a midwife, just before visiting a doctor. The invitation to the study was addressed to couples, as well as individual patients. After visiting a specialist, people who agreed to participate in the study were invited to a separate room, and they were informed by the interviewer about the purpose of the study, it's anonymity and the right to withdraw their participation at any time without giving any reason. The completion time of the study was estimated for 20 min. Five hundred questionnaires were administered to the voluntary participants within the period June 2019 to February 2020, 472 questionnaires were returned and for the final analysis 456 fully completed questionnaires were used (91%).

2.2. Tools

In the paper-pencil study 3 tools were used: author's questionnaire for the collection of socio-demographic data and medical information about respondents. Personal Information Form (PIF) and two standardized tools: Rosenberg Self-Esteem Scale (SES) and Acceptance of Illness Scale (AIS).

2.2.1. Personal information form

The author's questionnaire allowed to determine the data of socio-demographic respondents (age, sex, education status, place of residence, duration of infertility) and clinical characteristics of participants (time of treatment, type and reason of infertility).

2.2.2. Self-esteem scale

To evaluate self-esteem of participants we used self-esteem scale (SES), developed by Rosenberg (43), the Polish adaptation of Łaguna et al. (53) that allows the measurement of a general level of self-esteem, which includes self-acceptance and the way one perceives oneself. It is a 10-item scale which are rated on a 4-point Likert scale (from "I definitely agree" to "I definitely disagree"). The final score is within a range from 10 to 40. A score of 10–25 points is defined as low level, 26–29 points as average level and high level 30–40 points. The Polish version of the SES has good psychometric properties, reliability measured by Cronbach's alpha was 0.83.

2.2.3. Acceptance of Illness Scale

Acceptance of Illness Scale—AIS developed by Felton, Revensson and Hinrichsen from the Center for Community Research and Action, Department of Psychology, New York University (54, 55). This scale is created to measure the disease acceptance and can be used in relation to every single illness. AIS was adapted to Polish conditions by Juczyński (56).

The AIS contains 8 statements describing the negative consequences of poor health, i.e., limitations and difficulties associated with the disease. In each statement, the respondent defines the current health situation on a five-point Liker scale (from "I definitely agree" to "I definitely disagree"). According to the key, grade 1 confirms poor adaptation to the disease, and grade 5 confirms acceptance of the disease. The sum of all points is a general measure of the degree of acceptance of the disease and ranges from 8 to 40 points. A score of <20 points is interpreted as low level, 20–30 points as a medium level and > 30 points as a high level. A high score means acceptance and adaptation to the disease and the absence of negative emotions associated with the disease. A low score means a lack of acceptance and adaptation to the disease, as well as a strong sense of social discomfort. The study used the scale in the Polish language version in Juczyński's adaptation, Cronbach's alpha 0.83 (56).

2.3. Ethical consideration

The study was conducted in accordance with the Declaration of Helsinki for medical research. Before conducting the research, the necessary approval was obtained from Bioethical Commission in Rzeszow University, Poland (resolution number: 2018/04/03).

2.4. Statistical analysis

Data analyses were performed using the program IBM SPSS Statistics 20 (SPSS Inc., Chicago, IL, United States) was used. To verify the occurrence of differences the chi-square tests was used. Descriptive statistics were conducted to present the data: frequency (n), percentage (%), arithmetic mean (M), and standard deviation (SD). After determining the distribution (not normal), the following nonparametric tests were used to compare the variables: Mann–Whitney Test (sex, place of residence, reason of infertility), and Kruskal-Wallis Test (level of education, duration of infertility). Spearman correlations (age) were also used. A probability level (p) less than 0.05 was considered significant.

3. Results

A total of 456 patients (women and men) from infertile couples who voluntary agreed to take part in the study and who fully completed the questionnaire were included into the project. Among patients 51.5% ($n = 235$) were women and 48.5% ($n = 221$) were men. The mean age of respondents was 33.85 years (standard deviation, $SD = 4.76$, range: 20–44 years). Most respondents ($n = 248$, 54.4%) lived in the city, had a higher educational level ($n = 295$, 64.7%). The majority of men and women surveyed were 30–34 years (40.4% vs. 33.9%). The majority of women and men indicated the city as their place of residence (55.7% vs. 52.9%). Patients from infertile relationships are mostly people with higher education, both women (74.5%) and men (54.3%). Secondary education was indicated by 23.4% of women and 31.2% of men. Compared to men (13.6%), there were relatively few women with vocational education (1.5%). Most women and men indicated the time of trying to have children in the range of 3–4 years (34.0% vs. 35.7%). Detailed characteristics of respondents is shown in Table 2.

The overall self-assessment score for the whole sample is 30.50 (15 ± 30), which indicates a high level from the sample. Similarly, in the case of AIS, the result is 32.4 (8 ± 40), which also gives a high score. In the study group, men obtained a slightly higher level of self-esteem than women (31.00 vs. 30.04 points). Also, men had a higher level of acceptance of the disease (33.12 vs. 31.80) than women (Table 3).

More than half of the respondents (55.7%) had high self-esteem ($n = 254$). Every third respondent obtained an average level of self-esteem ($n = 152$, i.e., 33.3%). Every tenth respondent (11% of people, $n = 50$) presented a low level of self-esteem.

In the study group, the majority of respondents, 71.1% of people ($n = 324$) also showed a high level of acceptance of the disease. The average (average) level of acceptance of the disease was presented by 25.0% of subjects ($n = 114$). Low acceptance of the disease was declared by 3.9% of people ($n = 18$). Every fourth respondent had an average level of acceptance of the disease.

In the further part of the study, the impact of selected socio-demographic and clinical factors on self-esteem and acceptance of the disease were analyzed. Socio-demographic variables were taken into account first: age, gender, education and place of residence.

Table 4 shows that the age of the respondents did not significantly affect the level of acceptance of the disease. However, with the age of the subjects, their self-esteem increased (rho = 0.132) ($p = 0.0049$).

The age did not significantly affect SES and AIS scores in both the female and male groups, although differences in rho values were noted, but they were not significant.

People with primary and vocational education had a reduced level of self-esteem (29.24 points) compared to people with secondary education (30.06) or higher education (30.84)—$p = 0.0382$.

Education did not significantly affect the level of disease acceptance ($p = 0.4506$). Place of residence did not significantly differentiate the level of self-esteem ($p = 0.8913$) and acceptance of the disease ($p = 0.4974$) of the surveyed patients (Table 5). There was no significant difference between SES and AIS scores in men and women according to place of residence (Table 6).

Then it was checked whether the clinical situation such as the time of trying to have children, the type of infertility, the reason of infertility affected self-esteem and the level of acceptance of the disease. There were no significant differences between the duration of infertility and the level of self-esteem measured by SES ($p = 0.7416$) and the level of acceptance of disease measured by AIS ($p = 0.4394$). Respondents with secondary infertility presented a higher level of self-esteem (31.68 points) than people with primary infertility (30.26 points), $p = 0.0162$. Small differences ($p = 0.1651$) suggested that people with secondary infertility had a higher level of acceptance of the disease (33.38 points vs. 32.25 points). Knowledge of the cause of infertility did not significantly differentiate the level of self-esteem ($p = 0.2531$) or the level of acceptance of the disease ($p = 0.9338$), both

TABLE 2 Characteristic of the investigated group (n=456).

Variable		Women (n=235)	Men (n=221)	Total (n=456)
		N (%)	N (%)	N (%)
Age (years)	24–29	52 (22.1)	37 (16.7)	89 (19.5)
	30–34	95 (40.4)	75 (33.9)	170 (37.3)
	35–39	70 (29.8)	74 (33.5)	144 (31.6)
	40 and more	18 (7.7)	35 (15.8)	53 (11.6)
Location	City	131 (55.7)	117 (52.9)	248 (54.4)
	Village	104 (44.3)	104 (47.1)	208 (45.6)
Education	Primary	1 (0.4)	2 (0.9)	3 (0.7)
	Vocational	4 (1.7)	30 (13.6)	34 (7.5)
	Secondary	55 (23.4)	69 (31.2)	124 (27.2)
	University	175 (74.5)	120 (54.3)	295 (64.7)
Duration of infertility (years)	1–2	79 (33.6)	71 (32.1)	150 (32.9)
	3–4	80 (34.0)	79 (35.7)	159 (34.9)
	5–6	47 (20.0)	42 (19.0)	89 (19.5)
	7 and more	29 (12.3)	29 (13.1)	58 (12.7)
Reason of infertility	Diagnosed	122 (51.9)	110 (49.8)	232 (50.9)
	Undiagnosed	113 (48.1)	111 (50.2)	224 (49.1)

TABLE 3 SES and AIS scores and sex of respondents.

Sex*		SES	AIS
Women	M	30.04	31.80
	SD	5.29	6.68
	Me	30.00	34.00
	Min.	15	8
	Max.	40	40
	IQR	7	10
Men	M	31.00	33.12
	SD	4.44	6.75
	Me	30.00	35.00
	Min.	20	8
	Max.	40	40
	IQR	6	10
Total	M	30.50	32.44
	SD	4.91	6.74
	Me	30.00	34.00
	Min.	15	8
	Max.	40	40
	IQR	7	10
	p	**0.0489**	**0.0100**

*Mann–Whitney test.
M, mean; Me, median; SD, standard deviation; Min. – minimum; Max. – maximum; IQR, interquartile range.

TABLE 4 SES and AIS scores and age of respondents.

Age**		SES	AIS
Women	Rho	0.121	0.079
	n	235	235
	p	0.0633	0.2285
Men	Rho	0.125	0.003
	n	221	221
	p	0.0642	0.9656
Total	Rho	0.132	0.056
	n	456	456
	p	**0.0049**	0.2326

Rho, Spearman rank correlation, n, sample size, p, probability.
**Spearman's rho coefficient tests.

TABLE 5 SES and AIS scores and socio-demographic variables.

Place of residence*		SES	AIS
City	M	30.38	32.66
	SD	5.09	6.56
	Me	30.00	34.00
	Min.	15	11
	Max.	40	40
	n	248	248
Village	M	30.64	32.18
	SD	4.71	6.95
	Me	30.00	34.00
	Min.	18	8
	Max.	40	40
	n	208	208
Total	M	30.50	32.44
	SD	4.91	6.74
	Me	30.00	34.00
	Min.	15	8
	Max.	40	40
	n	456	456
p		0.8913	0.4974
Education***		SES	AIS
University	M	30.84	32.90
	SD	5.04	6.15
	Me	31.00	34.00
	Min.	15	12
	Max.	40	40
	n	295	295
Secondary	M	30.06	31.90
	SD	4.53	7.18
	Me	30.00	34.00
	Min.	16	8
	Max.	40	40
	n	124	124
Primary/Vocational	M	29.24	30.57
	SD	4.94	9.12
	Me	29.00	31.00
	Min.	19	8
	Max.	40	40
	n	37	37
Total	M	30.50	32.44
	SD	4.91	6.74
	Me	30.00	34.00
	Min.	15	8
	Max.	40	40
	n	456	456
p		**0.0382**	0.4506

*Mann–Whitney test. ***Kruskal-Wallis test.
M, mean; Me, median; SD, standard deviation; Min., minimum; Max., maximum; IQR, interquartile range.

in the general group and in groups women and men. Details are shown in Tables 7, 8.

4. Discussion

Infertility is a complex medical, psychological, and social problem that affects many aspects of life (57). Our study aimed to determine the factors which affect the level of self-esteem and the degree of acceptance of the disease in infertile patients.

The results of our research confirmed that the overall level of self-esteem for the studied group of patients from infertile relationships was high for the vast majority of respondents.

Previous qualitative studies have shown that infertile individuals have reduced self-esteem in comparison to the fertile group (39–41). Jamil et al. in their study observed that the self-esteem score of infertile men were significantly lower as compared to a control group of fertile men (39). Similarly, in a study Kamal et al. who concluded that infertile males had lower self-esteem than fertile males and it made them more liable to have personal as well as social problems (58). Higher self-esteem has a positive effect on the course of treatment and can mitigate the negative impact of infertility stress on depression or anxiety (15).

Zayed and El-Hadidy and Behboodi-Moghadam et al. confirm a loss of self-esteem in infertile women compared to women having children (59, 60). Cox et al. confirmed levels of self-esteem did not differ, in women whose pregnancies were the result of IVF compared to women whose pregnancies were the result of natural conception. In both groups, self-esteem increased as the pregnancy progressed. In addition, self-esteem was negatively correlated with anxiety during pregnancy, i.e., as women's self-esteem increased, anxiety decreased (48).

The results of our study showed that self-esteem depends on sex. In the study group, women shown lower levels of self-esteem than men. Similar results were obtained by El Kissi et al. and Wischman et al., where the average self-esteem score of women was also lower than in men (10, 41). Moreover Boivin et al. observed that lower self-esteem in women was often a reaction to a diagnosis of infertility in a relationship (61). Kamal et al. identified that infertile men have lower self-esteem compared to the group of fertile men (58). Reduction in self-esteem in infertile men was also confirmed in studies by Sultan and Tahir (62), Zouari et al. (63), and Xing et al. (64).

In many countries the perception of infertility is determined by a cultural factor (22). According to current medical knowledge, infertility can be caused by a female, male, or mixed factor (2, 3). However, in many countries, it is still wrongly perceived that only the woman is responsible for infertility in a relationship (22, 33). For this reason, regardless of the cause of infertility, childless women are stigmatized, discriminated against, and excluded by the family and society (65), and men do not participate in tests confirming their fertility (22).

Our study also confirms the dependence of self-esteem on education. Those who were better educated had higher levels of self-esteem, this is consistent with Xing et al. results, although Jamil et al.'s research showed otherwise, i.e., higher self-esteem was presented by respondents with a lower level of education (39, 64).

TABLE 6 SES and AIS scores and socio-demographic variables by gender.

		SES		AIS	
		Woman	Man	Woman	Man
Place of residence*					
City	M	29.75	31.09	31.66	33.77
	Me	30.00	31.00	33.00	36.00
	SD	5,49	4.52	6.92	5.97
	Min.	15	21	11	12
	Max.	40	40	40	40
	IQR	7	6	9	8
Village	M	30.40	30.88	31.97	32.38
	Me	29.50	30.00	34.00	34.00
	SD	5.02	4.38	6.39	7.50
	Min.	18	20	8	8
	Max.	40	40	40	40
	IQR	7	6	10	10
p		0.4840	0.5021	0.9437	0.3255
Education***					
University	M	30.41	31.48	32.48	33.51
	Me	30.00	31.00	34.00	35.00
	SD	5.28	4.62	6.22	6.01
	Min.	15	21	15	12
	Max.	40	40	40	40
	IQR	7	6	10	8
Secondary	M	29.05	30.87	30.13	33.32
	Me	29.00	30.00	32.00	35.00
	SD	5.03	3.94	7.43	6.69
	Min.	16	22	8	8
	Max.	40	40	40	40
	IQR	6	6	11	10
Primary/ Vocational	M	28.00	29.44	26.40	31.22
	Me	28.00	29.00	28.00	33.00
	SD	7.45	4.56	9.29	9.06
	Min.	19	20	11	8
	Max.	39	40	36	40
	IQR	13	5	14	12
p		0.1278	**0.0320**	**0.0397**	0.7686

*Mann–Whitney test. ***Kruskal-Wallis test.
M, mean; Me, median; SD, standard deviation; Min., minimum; Max., maximum; IQR, interquartile range. Bold *p* value = statistically significant.

We did not observe any significant relationship between time of infertility and self-esteem in our respondents. It was different than other studies, where the self-esteem of the respondents decreased along with the duration of infertility (39–41, 49).

According to the results of the present study, respondents also presented a high level of acceptance of the disease. Differences between men and women were also shown and the level of acceptance of the disease was higher in men. Also, people with secondary infertility had a higher level of acceptance of.

TABLE 7 SES and AIS scores and clinical variables.

Duration of infertility***		SES	AIS
1–2	M	30.79	32.67
	SD	5.10	6.96
	Me	31.0	34.5
	Min.	15	11
	Max.	40	40
	n	150	150
3–4	M	30.21	32.51
	SD	5.37	5.89
	Me	30.0	34.0
	Min.	16	13
	Max.	40	40
	n	159	159
5–6	M	30.66	32.44
	SD	3.43	7.88
	Me	30.0	35.0
	Min.	23	8
	Max.	38	40
	n	89	89
7 and more	M	30.31	31.66
	SD	5.12	6.55
	Me	29.0	33.0
	Min.	20	15
	Mx.	40	40
	n	58	58
Total	M	30.50	32.44
	SD	4.91	6.74
	Me	30.0	34.0
	Min.	15	8
	Max.	40	40
	n	456	456
p		0.7416	0.4394
Reason of infertility*		SES	AIS
Diagnosed	M	30.72	32.65
	SD	5.04	6.27
	Me	30.0	34,0
	Min.	15	11
	Max.	40	40
	n	232	232
Undiagnosed	M	30.27	32.22
	SD	4.79	7.20
	Me	30.0	34.0
	Min.	16	8
	Max.	40	40
	n	224	224

(Continued)

TABLE 7 (Continued)

Duration of infertility***		SES	AIS
Total	M	30.50	32.44
	SD	4.91	6.74
	Me	30.0	34.0
	Min.	15	8
	Max.	40	40
	n	456	456
p		0.2531	0.9338

*Mann–Whitney test. ***Kruskal-Wallis test.
M, mean; Me, median; SD, standard deviation; Min., minimum; Max., maximum; IQR, interquartile range.

the disease, which corresponds to Dembinska's results. In her study acceptance of infertility was also correlated with the type of infertility and lower acceptance of their own disease was observed in women with primary infertility. Dembinska confirmed that age also influenced the level of acceptance of the disease and higher acceptance by infertile women in the older age group. They also reported greater life satisfaction, a better perception of social support and a higher level of hope for the success of the treatment. The same study confirmed that higher the acceptance of the disease, lower the anxiety and depression in women (52). Our study did not confirm significant differences between patients' age and disease acceptance.

Acceptation of infertility can also mean accepting childlessness or deciding to adopt in the long run. Patients vary in the degree of acceptance of infertility at different stages of treatment (66). Infertile women, especially in a situation where infertility lasted a long time, more easily reconciled with the facts and were willing to accept infertility treating it as their fate and destiny (36). Significant differences between men and women have also been observed in our previous studies. Only every fourth female and nearly every second male were able to accept the lack of offspring. On the other hand, more women than men declared for adoption (32). Which was consistent with Pash et al. results, where having a child was more important for women than for men (67).

As already mentioned, there are not so many studies devoted to the acceptance of one's own infertility using AIS. The term "adjustment to infertility" appears much more often in the literature. Which can be understood as acceptance of the current situation during infertility treatment. Glover et al. explains that adapting to fertility problems is a way in which people recognize and process information about the course of their fertility problem and its treatment and possible consequences, i.e., the level of adaptation to having or not having a child in the future (66).

Better adaptation to infertility occurs in couples with greater social support and in a better financial situation (49). Study by Mahajan et al., adaptation to infertility situations was dependent on religiosity, family support, and sexual satisfaction (68). Similar dependencies are confirmed by Kroemeke and Kubicka, i.e., male gender, less social support, and shorter duration of infertility were related to better adjustment as well as with fewer symptoms of depression (69). On the other hand, Besharat et al. did not show a significant difference between men and women in terms of adjustment to infertility (70).

TABLE 8 SES and AIS scores and clinical variables by gender.

		SES		AIS	
		Woman	Man	Woman	Man
Duration of infertility***					
1–2	M	30.59	31.00	31.97	33.44
	Me	31.00	31.00	33.00	36.00
	SD	5.60	4.50	6.83	7.08
	Min.	15	21	11	11
	Max.	40	40	40	40
	IQR	8	7	10	10
3–4	M	29.46	30.97	32.06	32.96
	Me	29.00	30.00	34.00	34.00
	SD	5.79	4.83	5.94	5.84
	Min.	16	21	15	13
	Max.	40	40	40	40
	IQR	8	7	9	9
5–6	M	30.40	30.95	32.06	32.86
	Me	30.00	30.50	34.00	35.50
	SD	3.60	3.25	7.73	8.12
	Min.	23	24	8	8
	Max.	38	38	40	40
	IQR	4	4	8	9
7 and more	M	29.52	31.10	30.17	33.14
	Me	29.00	30.00	30.00	34.00
	SD	5.29	4.91	6.46	6.40
	Min.	21	20	15	17
	Max.	40	40	40	40
	IQR	9	6	9	10
p		0.4934	0.9995	0.3613	0.3613
Reason of infertility*					
Diagnosed	M	30.21	31.29	32.22	33.13
	Me	30.00	31.00	34.00	34.00
	SD	5.46	4.48	6.45	6.05
	Min.	15	20	11	12
	Max.	40	40	40	40
	IQR	8	6	9	9
Undiagnosed	M	29.85	30.70	31.35	33.11
	Me	29.00	30.00	33.00	36.00
	SD	5.11	4.41	6.91	7.41
	Min.	16	21	8	8
	Max.	40	40	40	40
	IQR	6	7	9	9
p		0.6339	0.2238	0.3541	0.5030

*Mann–Whitney test. ***Kruskal-Wallis test.
M, mean; Me, median; SD, standard deviation; Min., minimum; Max., maximum; IQR, interquartile range.

5. Limitations

Our study is based on a single observation and there was no control group, due to this reason generalization of findings is limited.

Another limitation was a relatively small sample size and the fact that all the patients were recruited from only one region of Poland. Our study focused on selected factors only, so the future research could consider other variables.

6. Conclusion

The level of self-esteem in patients in infertile couples increases with age and the level of education. There are also significant differences between women and men, i.e., positive correlations between the level of education and self-esteem in men and the degree of acceptance of the disease in women. Clinical factors did not determine the results of SES and AIS. The results may be relevant to practitioners involved in the design and implementation of procedures addressed to couples with unexplained infertility. Interdisciplinary actions should be taken to implement therapies to strengthen self-esteem in infertile patients into infertility treatment procedures, which may contribute to reducing stress and better acceptance of one's own infertility.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Bioethical Commission at Rzeszów University, Poland (resolution number: 2018/04/03). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

MN: conceptualization, writing-original draft preparation, data curation, and methodology. MN and BZ: formal analysis. MN and BO: investigation. MN, BZ, and DD-K: writing—review and editing. MN, BO, and DD-K: supervision. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Psychiatric referrals to the general hospital emergency department: are we being effective?

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Introduction: General hospital emergency departments (GHEDs) are notoriously overcrowded. This is caused, in part, by ineffective referrals, that is to say referrals that do not require medical examination or other interventions in the context of a general hospital. This study aims to investigate the contribution of psychiatric referrals to this issue, to identify potential determinants of these referrals and offer means to reduce them.

Materials and methods: Retrospective data were collected from psychiatric admission files within a GHED of a tertiary-care city hospital over a 1 year period. Two experienced clinicians separately reviewed each file to determine rationale of referrals according to predetermined criteria.

Results: A total of 2,136 visits included a psychiatric examination, 900 (42.1%) were determined “effective,” and 1,227 (57.4%) were deemed “potentially ineffective.” The leading causes for potentially ineffective referrals to a GHED were psychiatric illness exacerbation (43.4%), and suicidal ideations (22%). Most referrals (66.9%) were initiated by the patient or their family, and not by a primary care physician or psychiatrist.

Conclusion: More than half of the psychiatric referrals did not necessarily require the services of a general hospital, and may be more suitable for referral to a dedicated psychiatric facility. Ineffective referrals to the GHED pose a burden on general hospital resources, and may be less effective for the psychiatric patients. This calls for clear guidelines for the provision of optimal emergency treatment for mental-health patients.

KEYWORDS

general hospital emergency department, overcrowding, mental health, psychiatric emergencies, appropriate referrals, emergency psychiatry, general hospital psychiatry

Introduction

Overcrowding of general hospital emergency department (GHED), in part caused by ineffective referrals, is a significant public health problem worldwide (1, 2). Overcrowding of GHEDs results in longer wait times and adverse health outcomes (3). Patients with psychiatric symptoms constitute a substantial proportion of GHED visits ranging from 3.4 to 12.5% of the overall workload of the GHED (4–7). These include patients with psychiatric illnesses, such as affective, anxiety or psychotic disorders, substance misuse, and/or trauma (7). Patients who are referred to a GHED are largely treated by medical staff who may be less proficient in managing patients experiencing a mental-health crisis compared to dedicated psychiatric facilities (8). The length of stay (LOS) for a psychiatric patient in the GHED is 3.2 h longer compared to non-psychiatric patients (9). Longer LOS has been found to be associated with more violent behavior among psychiatric patients, possibly due to the busy GHED environment which can exacerbate mental distress (8–10). Therefore, clarifying which patients need to be referred to a GHED, and which should receive care in dedicated psychiatric facilities, is crucial to reduce GHED workload and minimize harm to patients.

Current research reveals a prevalence of between 20 and 40% of inadequate referrals to emergency departments (EDs) (11, 12). However, these studies focus on medical, rather than behavioral circumstances. Nevertheless, causes of ineffective referrals may be applicable to psychiatry as well, including the use of GHED as a substitute for primary care, mainly due to shortage in primary care services or the need for services outside regular hours. Ensuring consistent primary health care has the potential to effectively address acute conditions and manage chronic disorders, diminishing the likelihood of exacerbations and need for urgent care (13). Further research into the specific needs of individuals with psychiatric illness is needed to ensure appropriate and timely care.

A psychiatric emergency is defined by the American Psychiatric Association as "an acute disturbance in thought, behavior, mood, or social relationship, which requires immediate intervention" (5), and refers first and foremost to the behavior of an individual and/or subjective feelings. Therefore, if an individual or his/her family seek help for a psychiatric emergency, it should always be available. Nevertheless, identifying patients that requires the services of a GHED to determine whether there is a physical illness that may be causing or exacerbating their psychiatric symptoms, as well as identify acute medical comorbidity that may occur together with psychiatric symptomatology, is crucial (14, 15). Consensus recommendations of the American Association for Emergency Psychiatry Task Force (15) advise new-onset psychiatric symptoms after the age of 45, patients 65 years and older, patients with delirium or cognitive deficits, focal neurological findings or evidence of head injury, substance intoxication, withdrawal, or exposure to toxins/drugs, decreased level of consciousness and abnormal vital signs, are at risk for a medical cause for their psychiatric symptoms, and therefore should undergo a physical evaluation in addition to a psychiatric examination (15). However, it is not known to what degree these recommendations are adhered to in clinical practice. Nevertheless, these recommendations suggest who may be these patients that will not require medical evaluation, and could undergo psychiatric assessments in a dedicated psychiatric service to decrease the ever-growing burden imposed upon the GHEDs.

In the current study we aimed first, to describe the current status of psychiatric referrals to a GHED of a tertiary-care hospital, and to determine how many of the referrals were effective, that is to say referrals that required medical evaluation and GHED facilities. Second, we aimed to identify psychosocial determinants associated with effective compared to potentially ineffective referrals to the GHED. The hypotheses were based upon clinical practice, as there are no previous studies addressing this issue. We hypothesized that the majority of cases referred to the GHED will not be in accordance with the above-mentioned recommendations, and may be appropriate for referral to dedicated psychiatric facilities, rendering them "potentially ineffective" referrals.

Materials and methods

Setting

The Hadassah Ein-Kerem Medical Center is a tertiary care hospital serving a catchment area population of 1 million inhabitants living in Jerusalem and its nearby area. Emergency psychiatric services in the GHED are available 24/7. Individuals who arrive at the ED are triaged at arrival according to their main complaint. Triage could be directly to a psychiatrist or any other physician from other disciplines who could later ask for psychiatric consultation, if needed. Laboratory or imaging tests are carried out, when necessary, to rule out or clarify medical causes for psychiatric symptoms. Israel's health-care system provides every Israeli citizen health care service under the National Health Insurance Law. Emergency psychiatric services are provided in general hospitals EDs or in dedicated psychiatric emergency rooms located in regional psychiatric hospitals.

Data

Retrospective anonymous data was collected from the admission files. Files of all the patients who were examined by a psychiatrist in the GHED in Hadassah Ein-Kerem Hospital over a 1 year period, between October 1st, 2015 and September 30th, 2016 were included. Filles were excluded from analysis due to major deficits in data ($n = 9$). Sociodemographic characteristics, past medical and psychiatric history, source of referral, presenting complaint, examination by a non-psychiatric physician, laboratory or imaging tests, diagnosis at discharge and visit outcomes were extracted and entered into an IBM SPSS Statistics database. Two experienced psychiatrists (SK and AS) separately assessed each referral, to determine whether it was an effective referral. When needed, a case-by-case discussion was conducted between raters until an agreement on the classification of the case was reached. The decisions were based primarily on the recommendations of the American Association for Emergency Psychiatry Task Force on Medical Clearance of Adult Psychiatric Patients (15), with additions which were based on clinical experience. The classification of a referral as "effective" was done according to the following criteria: (1) Suicide attempt, (2) Pregnant and postpartum women with behavioral complaints, (3) Patients presenting to the GHED following significant self-harm, (4) Suspected first psychotic episode, (5) Acute behavioral changes after the age of 60, (6) Psychiatric patients with comorbid physical illness, (7) Patients who arrived to the GHED after exposure to a traumatic event (e.g., terror attack), (8) Acute intoxication, and (9) Mixed behavioral and physical symptoms. All referral that did not meet the above listed criteria were defined as "potentially ineffective" referrals.

The study was reviewed and approved by the Hadassah Hebrew University Medical Center Ethics Committee. Written informed consent was not required in accordance with institutional and national policies.

Statistical analyses

Descriptive analysis and examination of the distributional properties of socio-demographic and clinical variables were carried out. To compare appropriate versus inappropriate referrals, we used t-tests for independent samples with continuous variables and $\chi 2$ with categorical variables. In the case of more than two categories, $\chi 2$ was followed by z-tests for independent proportions with Bonferroni correction. Reported p values are two-sided. All analyses were performed using IBM SPSS 21.0 (IBM Corp 2012) statistical software. The level of statistical significance was set at 5% (two-sided) for all tests.

Results

Out of a total of 71,706 referrals to the Hadassah Ein-Kerem GHED, 2,136 (2.98%) underwent a psychiatric examination. 900 (42.1%) of the referrals were defined as "effective," according to the criteria defined above. 1,227 (57.4%) of the referrals were considered "potentially ineffective," with an additional of 9 (0.4%) that we were excluded due to lack of information.

Causes of referrals

Effective referrals to the GHED included individuals referred due to suicide attempts (28.9%), first psychotic episode (16.1%), psychiatric deterioration in physically-ill patients (13.9%), self-injury (11.1%) and behavioral change in the elderly (8.7%). The main causes of potentially ineffective referrals were: exacerbation of known mental illness (43.4%), specifically 17.6% due to psychotic exacerbation, 22% due to suicidal ideation or threats (without significant self-harm or suicide attempts), and 11% due to anxiety symptoms. See Figure 1 for more details on effective and ineffective causes for referral to the GHED. As shown in Table 1, medical history was significantly associated with more effective GHED referrals, while psychiatric history was related to more potentially ineffective referrals. Psychiatric diagnoses related to more potentially ineffective referrals were: schizophrenia, developmental/conduct disorders, and anxiety disorders. Whereas, personality disorders, dementia and mental disorders due to physical conditions, and referrals with no psychiatric diagnosis were associated with more effective referrals.

Psychosocial determinants associated with effective referrals

The socio-demographic characteristics and psychosocial correlates of the effective and ineffective referrals are shown in Table 2. Being male, Israeli-born, single, and unemployed were significantly associated with more potentially ineffective referrals. Being retired was significantly related to more effective ones. Referrals of patients who are 19 years old or younger, 30 to 39 years old, and 50 to 59 years old were more likely to be potentially ineffective, while referrals of patients aged 60 years or older were significantly associated with being more effective. Living in a rehabilitation facility was associated with more effective referrals.

Characteristics of GHED referrals

Most of the referrals (66.9%) were initiated by the patients or their families, 13% by a non-psychiatric doctor, 5.98% by a psychiatrist, and 14.2% were brought to the ED by ambulance or police. Hours of visit at GHED: about a third, 717 (33.6%) approached the ED between

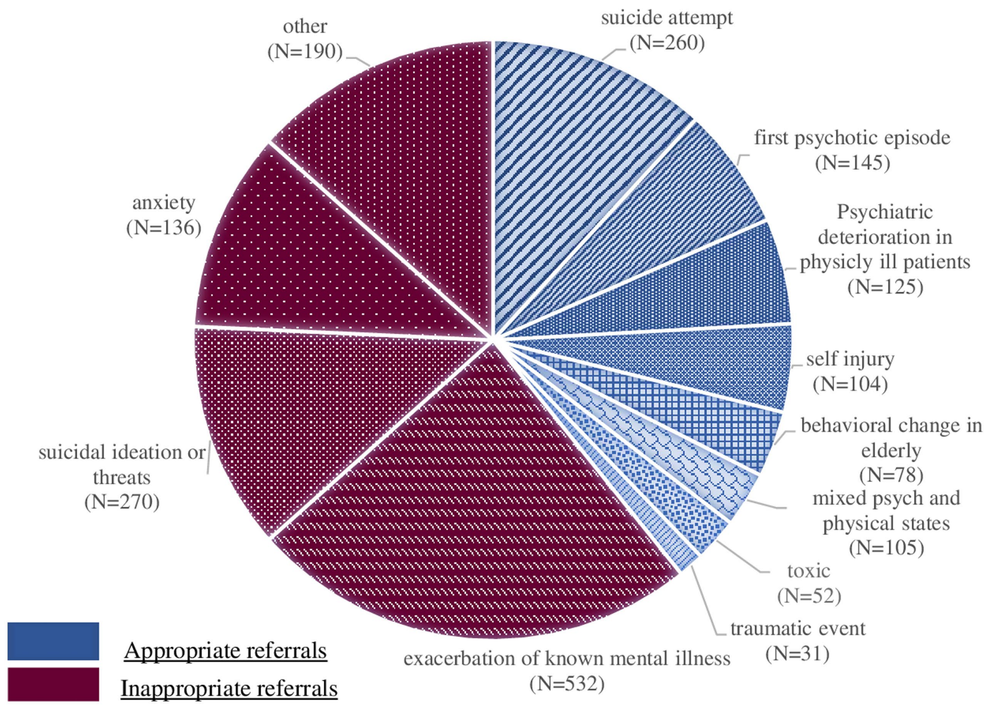

FIGURE 1
Effective and potentially ineffective causes of referrals to GHED.

TABLE 1 Effective psychiatric referrals to GHED and previous medical, psychiatric history and diagnosis.

	Total *n* = 2,127	Effective referrals *n* = 900	Potentially ineffective referrals *n* = 1,227	χ^2	*df*	*p*
Known medical history	769 (36.3%)	347 (38.8%)	422 (34.5%)	4.07	1	0.044
Previous medical hospitalization	583 (27.6%)	267 (29.9%)	316 (26.0%)	3.88	1	0.055
Known psychiatric history	1,487 (70.1%)	590 (65.8%)	897 (72.2%)	13.71	1	<0.001
Previous psychiatric hospitalization	783 (37.0%)	323 (36.2%)	460 (37.7%)	0.50	1	0.494
Previous psychiatric diagnosis				168.22	9	<0.001
None	548 (25.9%)	272 (30.4%)	276 (22.6%) *			
Schizophrenia	370 (17.5%)	92 (10.3%)	278 (22.8%) *			
Affective disorders	323 (15.3%)	123 (13.7%)	200 (16.4%)			
Personality disorders	318 (15.0%)	184 (20.5%)	134 (11.0%) *			
Developmental/Conduct disorders	189 (8.9%)	53 (5.9%)	136 (11.2%) *			
Anxiety and stressor related disorders	146 (6.9%)	53 (5.9%)	93 (7.6%) *			
Drug induced mental disorders	118 (5.6%)	68 (7.6%)	50 (4.1%) *			
Eating disorders	49 (2.4%)	15 (1.7%)	34 (2.8%)			
Dementia & mental disorders due to physical conditions	35 (1.7%)	33 (3.7%)	2 (0.2%) *			
Other mental disorder	19 (0.9%)	3 (0.3%)	16 (1.3%) *			

*Columns proportions significantly differ from each other.

7:00 AM and 2:59 PM, the majority, 982 (46%) between 3:00 PM and 10:59 PM, and only 434 (20.4%) between 11:00 PM and 6:59 AM. For the majority of the sample (1,622, 76.1%) this was the first referral in 6 months, 256 (12%) had two referrals, and 253 (11.9%) had three or more referrals to GHED in the last 6 months. No significant associations were found between effective referrals and the source of referral ($\chi^2_{(3)} = 1.64$, $p = 0.65$), hours of visit ($\chi^2_{(2)} = 2.31$, $p = 0.316$), or frequency of referrals to the GHED ($\chi^2_{(2)} = 4.40$, $p = 0.111$).

Discussion

As far as we know, this is the first study to investigate the effectiveness of referrals of adult psychiatric patients to a GHED, and to determine their nature, its magnitude and related characteristics. Our results demonstrate that about 58% of patients referred to the GHED during the study period did not need the facilities of a general hospital, and could have been referred directly to ED services in dedicated psychiatric facilities, and were therefore deemed as potentially ineffective. The leading causes for potentially ineffective referrals to the GHED were exacerbation of known mental illness (43.4%) and suicidal ideation (without significant self-harm behaviors and/or suicide attempts) (22%). A previous study of inappropriate pediatric psychiatric ED visits showed similar rates, defining only 39% of referrals as "fully appropriate." Multivariate predictors of inappropriate referrals included children with suicidal ideation or attempts, low harm potential and severity of presenting complaint, and pediatric patients without diagnosis of psychosis (16). The high proportion of potentially ineffective referrals to the GHED could be explained by several factors. First, it may reflect a shortage of adequate and accessible dedicated psychiatric services in the community (17). Research shows that many psychiatric crises could have been managed successfully in a primary-care setting (13). Second, perceived stigma associated with being in psychiatric care or approaching a dedicated psychiatric facility could also increase patients' preferences for a GHED (18–20). Increasing public awareness of mental health to reduce stigma may increase willingness to approach psychiatric services and psychiatric EDs. Finally, inadequate continuity of care and lack of communication between community-care providers and hospital staff could contribute to ineffective referrals to the GHED (21). Educating primary care physicians, individuals with psychiatric illnesses and their families regarding the indications for psychiatric hospitalization, and in which cases the services of a GHED may be needed to further evaluate medical causes for the psychiatric symptoms is warranted. Health-care organizations should have clear guidelines for physicians to help reduce ineffective self-referrals through policy and insurance payments.

About a third of referrals to the GHED in this study were due to a suicide attempt, suicidal ideations or self-harm thoughts or actions. Studies show that the point prevalence of active suicidal ideation can be up to 8% among GHED referrals presenting with non-psychiatric complaints. Suicide screening of all patients attending the GHED should be considered since it has the potential to improve identification and apply interventions to reduce subsequent suicidal behavior (22). Furthermore, it is estimated that up to 25% of United State (US) patients that visit GHEDs due to suicidal attempt, will make another attempt (23). In the ED-SAFE study (24) conducted across multiple centers, involving patients who visited ED due to recent suicide attempts, showed that mere screening did not establish any significant change but an intervention that was implemented showed a significant reduction in subsequent suicide attempts, with a 5% absolute decrease in the proportion of patients attempting suicide and a 30% decrease in the total number of suicide attempts over a 52 weeks follow-up period compared to treatment as usual (24). ED visits offer a window of opportunity to deliver prevention interventions, and to provide rapid referral to outpatient care. US national statistics indicate

TABLE 2 Psychosocial correlates with effectiveness of referral to GHED.

	Total *n* = 2,127	Effective referrals *n* = 900	Potentially ineffective referrals *n* = 1,227	χ^2/t	*df*	*p*
Male	1,070 (50.3%)	413 (45.9%)	657 (53.6%)	12.31	1	0.001
Born in Israel	1,630 (77.1%)	652 (73.0%)	978 (80.0%)	14.39	1	<0.001
Single	1,235 (58.3%)	486 (54.5%)	749 (61.1%)	9.10	1	0.003
Employment status				48.28	2	<0.001
Employed	532 (26.0%)	231 (26.8%)	301 (25.4%)			
Unemployed	1,372 (67.0%)	533 (61.8%)	839 (70.8%) *			
Retired	144 (7.0%)	99 (11.5%)	45 (3.8%) *			
Age mean		38.51 ± 20.84	33.57 ± 16.18	5.93	2,125	<0.001
Age categories				74.38	5	<0.001
≤19	390 (18.3%)	139 (15.4%)	251 (20.5%) *			
20–29 y	603 (28.3%)	266 (29.6%)	337 (27.5%)			
30–39 y	431 (20.3%)	158 (17.6%)	273 (22.2%) *			
40–49 y	231 (10.9%)	90 (10.0%)	141 (11.5%)			
50–59 y	188 (8.8%)	65 (7.2%)	123 (10.0%) *			
≥60	284 (13.4%)	182 (20.2%)	102 (8.3%) *			
Living in a rehabilitation facility	194 (9.2%)	95 (10.6%)	99 (8.1%)	3.96	1	0.047

*Columns proportions significantly differ from each other.

that only roughly half of youth presenting to GHEDs with suicidal ideation or self-harm, receive outpatient treatment after discharge. There is a need for programs that can be an alternative to the GHED for people who are at risk, for example mobile emergency psychiatric services and a mobile crisis intervention team. Furthermore, Individuals who approach the GHED after a suicide attempt should be offered extended observation for up to 72 h. This approach could provide time for evaluation, monitoring, and a brief intervention that could reduce future attempts (23) and thus will reduce GHED visits.

Our results show being single and unemployed was also associated with a higher likelihood of more potentially ineffective referrals. Previous studies of frequent visitors to psychiatric EDs suggest being single, living alone, and being economically disadvantaged may be related to a lack of social support and social isolation (25, 26). However, the latter studies did not examine the adequacy of GHED visits. We did not find a significant relationship between the frequency of GHED visits and potentially ineffective referrals. These psychosocial characteristics may be related to the initial psychiatric diagnosis rather than the circumstances of the referral to the GHED. Future research is needed regarding sub-groups of patients who may be more likely to have potentially ineffective referrals, which may contribute to GHED workload and crowding. The majority of potentially ineffective referrals to the GHED in the study included patients with exacerbation of known psychiatric disorders. Yet, most of the referrals (66.9%) were initiated by patients or their families, and not by their primary-care physician or psychiatrist. It would be expected that individuals with existing mental illness would be under psychiatric follow-up, and would be referred to the ED when the treating psychiatrist decides that the mental condition warrants hospitalization. This may attest to the shortage of outpatient psychiatric services in the community and therefore, expansion of psychiatric service in the community is needed. Self-referrals are one of the major causes of overcrowding of EDs and improper use of emergency services (27). Studies show a majority of medical self-referrals are also inappropriate (28). A literature review regarding patients' motives for self-referrals to EDs concludes that the most common motives for self-referrals include health concerns and the patients' expectation for further investigations of their complaints in the ED (29). This would not constitute an appropriate reason for a referral to the ED, medical or psychiatric, but rather should undergo further evaluation in community-setting. Interventions that educate patients and families regarding their illness have been shown to significantly reduce nonurgent ED visits (29). Increasing patients' knowledge and awareness regarding recommended care in case of symptom exacerbation and suicidal thoughts could reduce potentially ineffective GHED referrals (30). According to our findings, living in a rehabilitation facility was associated with more effective referrals. Therefore, we suggest that developing more community rehabilitation services for individuals with serious mental illness may help reduce ER visits during momentary crises. This suggestion is supported by evidence that people with serious mental illness who receive rehabilitation services for more than one year show a decrease in the mean number of psychiatric hospitalization days per year (31). Health care policy should promote services that provide accessible alternatives to the GHED. Channeling patients to easily accessible, community services or urgent care centers, may also help mitigate GHED workload and allow more time and resources to treat populations with psychiatric symptoms, such as pregnant women, patients with eating disorders, young children, and geriatric patients, who should be evaluated in a GHED to exclude physical medical issues that require immediate attention (32, 33).

Strengths and limitations

The strength of this study is in the comparably large sample size. As to the limitations, the study was based on hospital records.

Therefore, the information presented here is limited. The effectiveness of the referrals was categorized by clinicians retrospectively and may be subjected to bias. Furthermore, the Israeli healthcare system provides universal healthcare coverage, including psychiatric services through public healthcare providers. Psychiatric emergency services are available in GHED and dedicated psychiatric facilities. This may limit generalizability to countries with different healthcare policies. Lastly, data presented in this study has been collected during 2015. Therefore, changes that may have occurred during this time, such as the pandemic and economic turmoil following it, may affect the results and need to be taken into account when interpreting the results.

Conclusion

The number of potentially ineffective referrals of psychiatric patients to GHED is substantial, and represents a major public-health concern due to its substantial burden on GHED workload and negative effect on the psychiatric patient's well-being and quality of care. Our results suggest that available recommendations for differential referral to psychiatric versus general hospital emergency care should be clearer. Guidelines for referrals of psychiatric patients in need by community service providers and patients alike are needed.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The study was reviewed and approved by the Hadassah Hebrew University Medical Center Ethics Committee. Written informed consent was not required in accordance with institutional and national policies.

Author contributions

ET and AS collected the data from the admission files. SK and AS determined clinical effectiveness of all admission files. OB and SL contributed to the experimental design. IR, SK, and SF wrote the manuscript. LC done the statistical analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Intercultural adaptation and influencing factors analysis of the Chinese version of the anxiety scale for the older adults in a long-term care population

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Objective: The purpose of this study was to translate the Geriatric Anxiety Scale-Long-Term Care into Chinese and to assess its reliability and validity in a long-term care population, as well as to explore factors contributing to anxiety in older adults requiring long-term care.

Methods: The study recruited 399 older adults residents requiring long-term care and used the Brislin double translation-back-translation method to create the initial Chinese version of the Geriatric Anxiety Scale-Long-Term Care. The study used internal consistency and split-half reliability to assess the reliability of the scale, as well as exploratory factor analysis, validation factor analysis, and content validity to assess the validity of the scale. Linear regression was used to analyze the relationship between the independent variables and anxiety levels in the long-term care population.

Results: The Cronbach's coefficient value of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care was 0.81, and the split-half reliability was 0.80. The results of exploratory factor analysis showed support for a one-dimensional factor structure. The results of the validation factor analysis indicated a good fit for the one-factor model. Gender ($\beta = 0.190$, 95% CI:0.540 ~ 1.546, $p < 0.001$), self-rated health ($\beta = 0.220$, 95% CI:0.379 ~ 0.953, $p < 0.001$), life satisfaction ($\beta = -0.315$, 95% CI: −1.355 ~ −0.734, $p < 0.001$) and participation in activities ($\beta = -0.106$, 95% CI: −1.122 ~ −0.084, $p < 0.05$) were significant predictors of anxiety levels in the long-term care population.

Conclusion: The Chinese version of the Geriatric Anxiety Scale-Long-Term Care has good reliability and validity in the long-term care population. The Geriatric Anxiety Scale-Long-Term Care is effective in assessing the anxiety level of the Chinese long-term care older adults population and provides an opportunity to detect and observe anxiety disorders in the long-term care population.

KEYWORDS

anxiety, assessment, older adults, factor analysis, linear regression

1. Introduction

The aging of the population is a major concern around the world. By the end of 2021, The population over the age of 65 was 20.56 million, and the population over the age of 60 was 267.36 million, making up 14.2 and 18.9% of the total population in China. The dependence rate for seniors 65 and over in China is 20.8% (1). The issue of old age has grown in importance as the population has aged.

The accelerated pace of aging, the increasing proportion of disabled and semi-disabled individuals, and the rising prevalence of chronic diseases have led to a continuous expansion of the demand for long-term care among the older adults. Moreover, the diseases suffered by older adults individuals are mostly chronic or age-related, with long recovery times and low cure rates, requiring prolonged long-term care. However, due to economic, work, and family pressures, family members are unable to provide the necessary care, leading to the need for long-term care facilities to care for the older adults. Research has shown that nearly 46% of all individuals aged 65 and above require long-term care services at some point, with more than half of them being admitted to long-term care facilities for care (2).

Anxiety has been found to be one of the most prevalent psychiatric disorders among older adults (3). Older people requiring long-term care often have anxiety symptoms and disorders that are exacerbated by admission to an LTC, and for older people, admission to an LTC creates greater mental stress, particularly in the first 4 weeks of admission (4). International epidemiological studies have shown that at least one-third of people living in LTCs will exhibit clinically significant symptoms of anxiety (5). Older people in LTCs are also more prone to anxiety because they are more frail, unfamiliar with their caregivers, most will have various comorbidities, and they are socially disconnected and at risk of losing their autonomy (6–8).

Anxiety in the LTC population can lead to poorer well-being (9), sleep problem (10), disability burden (11), reduced memory and executive functioning (12), and increased caregiver burden (13). Chang et al. (14) analyzed 247 older persons aged 60 years and older with anxiety and found a significant 2.05-fold increase in mortality compared to those without anxiety. Anxiety symptoms complicate caregiving and can significantly increase the workload of caregivers. Anxiety also imposes a heavy social burden, both directly in the form of personal distress and indirectly in the form of a substantial need for medical support to manage anxiety-induced physical symptoms. The underestimate, underdiagnosis, and subsequent undertreatment of this category of illnesses may increase these socioeconomic costs (3).

Anxiety symptoms in older adults residents of long-term care facilities cannot be ignored, and attention must be paid to screening for anxiety symptoms and their risk factors, and treating them promptly. However, because LTC facilities always adopt a model of care that prioritizes the physical requirements of senior citizens, residents' anxiety symptoms and disorders are also often overlooked and under-treated (15–17). The reason for this situation may be due to a shortage of personnel in long-term care facilities. According to international standards, the ratio of caregivers to disabled older adults individuals should be 1: 3, and China needs at least 14 million caregivers. However, there are currently only 300,000 caregivers, of which only 40,000 have obtained qualifications for older adults care.

With the increasing number of older adults individuals living in long-term care facilities, there is an urgent need for accurate diagnosis and treatment of anxiety in this population. Meanwhile, China is facing a shortage of caregivers, making it particularly important to have a reliable, effective, and efficient tool for identifying anxiety disorders in long-term care facility residents. The Geriatric Anxiety Scale-Long-Term Care is a self-report assessment scale consisting of ten items that are answered directly with a "yes" or "no" format, making it easy for diagnosis. Currently, there is no specific measurement tool for anxiety disorders in older adults individuals requiring long-term care in China. Therefore, the purpose of this study is to introduce and evaluate the reliability and validity of the Geriatric Anxiety Scale-Long-Term Care scale in China and to explore the factors that influence anxiety in this population.

2. Methods

2.1. Participants

This cross-sectional study was conducted from May 2022 to October 2022 and involved eight long-term care facilities in Nanyang City, Henan Province, China. The researchers traveled to the eight long-term care facilities after receiving relevant training and recruited participants with the assistance of the long-term care facility supervisors. Participants were recruited from the facilities through convenience sampling, and participants included 399 older adults. Inclusion criteria required participants to be older adults greater than or equal to 60 years of age, in need of long-term care and volunteering for this study. Participants were excluded from the study when their perceptions interfered with their ability to fully understand the study and give informed consent. Participants were contacted by the researcher and after permission to participate and informed consent was obtained, participants completed an anonymously translated scale at their residence. In addition, to explore the factors influencing anxiety in the long-term care population, a further 374 data were collected for a follow-up study from November 2022 to March 2023 for this study. It is recommended to have a sample size for exploratory analysis that is 5–10 times the number of variables in the project (18). For regression analysis, a sample size of 20 times the number of predictor variables is suggested (19). In this study, the scale used consists of 10 items and there are 11 predictor variables. Therefore, the sample size of this study meets the requirements.

2.2. Translation process

Before starting the study, we had obtained permission and approval from Prof. Segel (2) to develop the Chinese language copyright of the tool. To ensure accuracy, we employed the principle of double back-translation, as recommended by Brislin (20). Initially, two bilingual native Chinese speakers translated the scale into Chinese. The research team then reviewed and discussed any obvious differences between the translated version and the original scale. Next, two English-speaking foreign scholars, who were not familiar with the original scale, back-translated the Chinese version into English. The research team compared and discussed the original scale, the Chineseized first draft, and the back-translated English scale to create a preliminary draft of the Chinese version. Additionally, a psychologist was consulted to make cultural adjustments to the Chinese version, making it more suitable for Chinese reading habits. To assess the comprehensibility of the scale, we selected 20 older adults in need of long-term care to participate in a pre-survey. The participants reported that the scale was well-structured and easy to understand. Overall, we took extensive steps to ensure the accuracy and cultural appropriateness of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale.

2.3. Instruments

The study questionnaire included demographic information and original scales. Demographic information includes age, gender, marital status, educational attainment, smoking history, drinking history, frequency of interaction with children, self-rated health, life satisfaction, whether officially retired, and activity participation. The Geriatric Anxiety Scale-Long-Term Care (2) is a self-assessment tool that effectively assesses anxiety levels in older adults receiving long-term care. The scale is specifically designed to assess anxiety over the past week and is therefore a valid tool for monitoring changes in anxiety levels over time. The Cronbach's coefficient for this scale is 0.81.

2.4. Ethics consideration

This study protocol was approved by the relevant Ethics Committee of Jinzhou Medical University (Ethics approval number: JZMULL2022095), and the study was conducted in accordance with the ethical guidelines of the Declaration of Helsinki.

2.5. Data analysis

This study used Mplus 8.0 and SPSS 25.0 for data analysis. A robust weighted least squares (WLSMV) estimator that was modified for mean and variance was utilized because the data in question was categorical. WLSMV, a trustworthy estimator that does not assume normally distributed variables, is the best choice for modeling categorical data (21).

2.5.1. Reliability analysis

A reliability test was conducted to assess the internal consistency of the Geriatric Anxiety Scale-Long-Term Care scale, including the computation of Kuder–Richardson-20 (KR-20) coefficient, split-half reliability, and corrected item-total correlations. The acceptable value for KR-20 coefficient, which indicates internal consistency, is 0.7 or above (22). The acceptable value for the corrected item-total correlations, which indicates the overall relatedness of the items, is 0.3 or above (22).

2.5.2. Validity analysis

2.5.2.1. Discriminant validity and factors correlation

The Geriatric Anxiety Scale-Long-Term Care Chinese version of the scale was ranked from highest to lowest total score and the relationship between the top 27% (high subgroup) and the bottom 27% (low subgroup) was analyzed to determine whether the translated scale was appropriately differentiated. Correlations between items and the translation scale and changes in Cronbach coefficient values if items were removed were examined to assess whether each item of the translation scale could be preserved.

2.5.2.2. Content validity

In this study, seven experts were invited to assess the content validity of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care by calculating the item content validity index (CVI) and the mean S-CVI (23). The CVI was calculated on a 4-point scale, with one denoting no relevance, two denoting low relevance, three denoting great relevance, and four denoting extremely high relevance. Each expert judged the extent to which each item was related to the scale.

2.5.2.3. Structural validity

To assess the structural validity of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale, EFA and CFA techniques were used. Two samples were created by randomly dividing the data. EFA was performed on Sample 1 ($n = 209$), and the KMO (Kaiser-Meyer-Olkin) statistic (24) and Bartlett's test of sphericity (25) were used for dimensionality. Based on the results of exploratory factor analysis, a validated factor analysis was performed on sample 2 ($n = 199$). Using squared degrees of freedom (χ^2/df), comparative fit index (CFI) (26), Tucker Lewis index (TLI) (27), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) to assess model fit. An acceptable model should have $x^2/\text{df} < 3$, RMSEA and SRMR <0.08, and CFI and TLI > 0.9 (21, 22).

2.5.2.4. Linear regression analysis

The Pearson correlation analysis method was employed to screen the independent variables and investigate their relationship with anxiety in terms of demographic variables. Variables showing significant correlations were selected as independent variables, with anxiety being the dependent variable. Stepwise selection method was utilized for conducting multiple linear regression analysis. To assess the effectiveness of the model, the adjusted R-squared is utilized to measure the goodness of fit, and the significance of the entire regression model is tested using the *F*-value and its corresponding *p*-value (19). The reliability of the model is evaluated through significance tests conducted on the regression coefficients, involving the calculation of standard errors, *t*-values, and *p*-values. This analysis determines the significance of the independent variables' impact on the dependent variable (19). The prediction factors (28) are examined by considering the direction and magnitude of the regression coefficients, which indicate the direction and strength of the relationship between the independent and dependent variables. Collinearity diagnosis and the plotting of a residual scatter plots are employed to conduct hypothesis testing for the model assumptions.

3. Results

3.1. Descriptive statistics

The demographic characteristics of the participants are detailed in Tables 1, 2. Scale Cultural Adjustment study participants (Table 1) were males (48.6%, $n = 194$) and females (51.4%, $n = 205$) with a mean age of 68.64 ± 5.887 years. Participants in the study of influences

TABLE 1 Demographic characteristics.

Characteristics	Total (*N* = 399) *N* (%)/M ± SD
Age(years)	68.64 ± 5.887
Gender	
Male	194 (48.6%)
Female	205 (51.4%)
Education level	
Primary school or below	316 (79.2%)
Junior high school	56 (14.0%)
High school or technical secondary school	13 (3.3%)
College degree or above	14 (3.5%)
Smoke	
Yes	177 (44.4%)
No	222 (55.6%)
Drink	
Yes	104 (26.1%)
No	295 (73.9%)

SD, standard deviation.

affecting anxiety in the long-term care population (Table 2) were males (48.1%, $n = 180$) and females (51.9%, $n = 194$) with a mean age of 68.85 ± 6.057 years.

TABLE 2 Demographic characteristics.

Characteristics	Total (*N* = 374) *N* (%)/M ± SD
Age(years)	68.85 ± 6.057
Gender	
Male	180 (48.1%)
Female	194 (51.9%)
Education level	
Primary school or below	305 (81.6%)
Junior high school	45 (12.0%)
High school or technical secondary school	10 (2.7%)
College degree or above	14 (3.7%)
Marital status	
Unmarried	71 (19.0%)
Married	55 (14.7%)
Divorced/widowed	248 (66.3%)
Smoke	
Yes	95 (25.4%)
No	279 (74.6%)
Drink	
Yes	167 (44.7%)
No	207 (55.3%)
Self-rated health	
Very good	11 (2.9%)
Good	12 (3.2%)
Fair	136 (36.4%)
Poor	147 (39.3%)
Very poor	68 (18.2%)
Life satisfaction	
Not at all satisfied	18 (4.8%)
Not very satisfied	37 (9.9%)
Somewhat satisfied	198 (52.9%)
Very satisfied	109 (29.1%)
Completely satisfied	12 (3.2%)
Participation activities	
Yes	139 (37.2%)
No	235 (62.8%)
Communication with children	
Yes	316 (84.5%)
No	58 (15.5%)
Retirement	
Yes	204 (54.5%)
No	170 (45.5%)

3.2. Item analysis

The item analyzes of the Geriatric Anxiety Scale-Long-Term Care are shown in Table 3. The critical ratio CR > 3.000 indicates that the scale has good discriminative validity of the entries, and the CR values of the 10 entries of the scale ranged from 7.351 ~ 29.173, which suggests that the scale has good discriminant validity. The correlation coefficients between the entries and the total score of the scale ranged from 0.348 ~ 0.743, and the differences were statistically significant. In addition, the internal consistency of the entire scale was not significantly improved by deleting items.

3.3. Reliability analysis

The Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale consists of 10 items. The KR-20 reliability coefficient is 0.81, Cronbach's alpha value is 0.81, and the split-half reliability is 0.80. The values of the correlation coefficients are all above 0.3. All of these findings indicate that the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale demonstrates good reliability.

3.4. Exploratory factor analysis and model comparison

The Bartlett's test for sphericity for exploratory factor analysis (EFA) was significant ($x^2 = 540.831$, $p < 0.001$), with a KMO index of 0.890. The results of the EFA showed that the factor loadings of the items ranged from 0.329 to 0.783 (Table 4).

Based on the factor distributions of EFA, a CFA model was constructed using MPLUS, and the model was fitted and analyzed.

TABLE 3 Reliability analysis.

Items	Yes	Mean	SD	Critical ratio	Correlation coefficient between item and total score	Cronbach's Alpha if item deleted
1	93 (44.5%)	0.44	0.498	29.173	0.743	0.768
2	67 (32.1%)	0.32	0.468	14.353	0.652	0.782
3	82 (39.2%)	0.39	0.489	13.915	0.599	0.789
4	88 (42.1%)	0.42	0.495	14.976	0.594	0.790
5	89 (42.6%)	0.43	0.496	15.905	0.618	0.787
6	99 (47.4%)	0.47	0.501	20.465	0.694	0.776
7	100 (47.8%)	0.48	0.501	7.351	0.348	0.821
8	107 (51.2%)	0.51	0.501	21.565	0.654	0.782
9	103 (49.3%)	0.49	0.501	12.414	0.559	0.795
10	63 (30.1%)	0.30	0.460	12.659	0.573	0.791

TABLE 4 Factor loadings for the Chinese version of the Geriatric Anxiety Scale-Long-Term Care.

	Items	Factor
1	I was irritable or grumpy	0.783
2	I felt detached or isolated from others	0.648
3	I felt like I was in a daze or foggy-headed	0.678
4	I had a hard time sitting still	0.505
5	I could not control my worry	0.595
6	I felt restless, keyed up, or on edge	0.735
7	I felt overly tired	0.329
8	My muscles were tense or tight	0.696
9	I felt like I had no control over my life	0.609
10	I felt like something terrible was going to happen to me	0.639

TABLE 5 Correlation analysis between total anxiety score and demographic variables.

Variables	Correlation	*p*	Variables	Correlation	*p*
Age	−0.110	0.034	Communication with children	−0.072	0.167
Gender	0.151	0.003	Participation activities	−0.109	0.034
Education level	−0.100	0.053	Retirement	−0.047	0.367
Self-rated health	0.287	0.000	Life satisfaction	−0.370	0.000
Drink	−0.127	0.014	Marital status	0.045	0.384
Smoke	−0.012	0.820			

The one-factor model fit index (x^2/df = 1.148, CFI = 0.992, TLI = 0.990, RMSEA = 0.066 [90% CI: 0.000 ~ 0.061], SRMR = 0.065). The results indicated a statistically acceptable fit for the one-factor model.

3.5. Content validity

Experts were invited to assess the content validity of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale (29). A total of seven experts were invited to conduct the assessment, and the results of the content validity analysis showed that the Geriatric Anxiety Scale-Long-Term Care has good content validity, with an I-CVI of 0.857 ~ 1.000 and an S-CVI/Ave of 0.971.

3.6. Multivariate regression linear analysis

The results of the correlation analysis are presented in Table 5, revealing significant correlations between anxiety and variables such as age, gender, self-rated health, drinking, activity participation, and life satisfaction ($p < 0.05$). These variables were selected as independent variables and subjected to multiple linear regression analysis. The findings indicated an adjusted R-squared value of 0.211, $F = 26.003$,

TABLE 6 Effect of sociodemographic factors on anxiety total scores: linear regression analysis.

Model	Beta	*t*	*p*	95% CI	VIF
Constant		3.655	0.000	1.629 ~ 5.422	1.073
Gender	0.190	4.075	0.000	0.540 ~ 1.546	1.020
Life satisfaction	−0.315	−6.611	0.000	−1.355 ~ −0.734	1.105
Self-rated health	0.220	4.560	0.000	0.379 ~ 0.953	1.026
Participation activities	−0.106	−2.284	0.023	−1.122 ~ −0.084	0.622

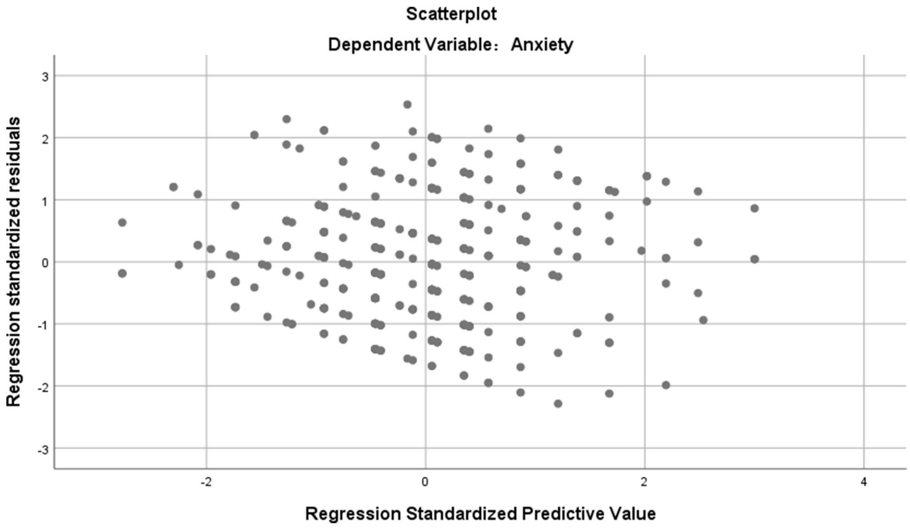

FIGURE 1
Residual scatterplot.

p < 0.001. The regression equation demonstrated statistical significance, suggesting a good fit between the independent variables and the outcome variable. Additionally, the variance inflation factor (VIF) values (Table 6) were all below 5, indicating no substantial multicollinearity issues. Furthermore, the residual plots exhibited no discernible patterns, indicating the absence of significant violations of regression assumptions (Figure 1). Overall, the model testing results were deemed satisfactory. The results of multiple regression analysis showed that the total score of the anxiety scale of the older adults in relation to gender ($\beta = 0.190$, 95% CI: 0.540 ~ 1.546, $p < 0.001$), life satisfaction ($\beta = -0.315$, 95% CI:−1.355 ~ −0.734, $p < 0.001$), self-rated health ($\beta = 0.220$, 95% CI: 0.379 ~ 0.953, $p < 0.001$), and activity participation ($\beta = -0.106$, 95%CI: −1.122 ~ −0.084, $p < 0.05$) were significantly correlated (Table 6).

4. Discussion

As the aging population increases, most older adults individuals face health challenges and functional decline, which may require long-term care support and increase the likelihood of experiencing anxiety symptoms. However, there is currently no specific measurement tool for anxiety symptoms in older adults individuals requiring long-term care in China. The Generalized Anxiety Scale (GAS) is commonly used in China to measure anxiety, but its lack of population specificity reduces sensitivity. Professor Segal (2) has developed the Geriatric Anxiety Scale-Long-Term Care scale specifically for long-term care populations based on their unique needs and characteristics, using a "yes" or "no" response mechanism to make answering easier. In order to fill the gap in the lack of anxiety assessment tools for long-term care populations in China, this study aims to translate and ensure the reliability of the Geriatric Anxiety Scale-Long-Term Care scale and introduce it to China. Additionally, this study explores the factors influencing anxiety in long-term care populations. The results of this study indicate that the Chinese version of the Geriatric Anxiety Scale-Long-Term Care is an effective and reliable tool for measuring anxiety symptoms in older adults individuals requiring long-term care in China.

According to Brislin's principles of translation, the Chinese version of the Geriatric Anxiety Scale-Long-Term Care was completed in this study, and the translation was adjusted by the research team according to the relevant guidelines and Chinese expression habits to ensure that the Chinese scale was fully equivalent to the original scale. In the pre-test, the Geriatric Anxiety Scale-Long-Term Care was administered to 20 older adults in the long-term care population, and it was found that the scale structure and semantics were simple and easy to understand. In addition, the critical ratios (CR) of all items of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale were > 3.000, and deletion of any item did not improve the internal consistency of the whole scale, indicating strong discriminant validity of the scale. The correlation coefficients between the items and the total score ranged from 0.348 ~ 0.743. The Cronbach's alpha value of the translated scale was 0.81, which was slightly higher than that of the original scale (2), and the split-half reliability was 0.80. Therefore, the Chinese version of the Geriatric Anxiety Scale-Long-Term Care scale has sufficient reliability among long-term care residents.

The reliability of the Geriatric Anxiety Scale-Long-Term Care was evaluated in this study by assessing its content validity and structural validity. The content validity was determined by calculating the Item-Content Validity Index (ICVI), which was found to be 0.8571, and the Scale-Content Validity Index (S-CVI), which was 0.971. These values were higher than the reference value for content validity (30), indicating that the Geriatric Anxiety Scale-Long-Term Care has strong content validity. Exploratory factor analysis revealed that one factor accounted for 40.124% of the total data variance, and the factor loading of each item was greater than 0.3 (31, 32), indicating good structural validity. Furthermore, we confirmed the one-factor model of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care with good overall model indicators. Based on these findings, we conclude that the Chinese version of the Geriatric Anxiety Scale-Long-Term Care is a valid tool for assessing anxiety in the long-term care facility resident population.

This study found that gender influences anxiety in the long-term care population, which is consistent with previous study (33–37) and may be related to the fact that women are more susceptible to negative influences (33). Additionally anxiety in the long-term care population was influenced by self-assessed health status, which is consistent with previous study (37–40) and may be due to the fact that higher self-assessed health is associated with more positive emotions. When individuals have higher self-health reports of their health status, it suggests that they are more confident in their health and are more likely to adopt a positive attitude towards life (41), which triggers the development of anxiety when people are concerned about the potential consequences of poor health (42). In addition, this study found that anxiety in the long-term care population was influenced by life satisfaction, which is consistent with previous study (43–45). It is not difficult to understand that life satisfaction reflects older adults' overall satisfaction with all aspects of their lives, and when they experience dissatisfaction or face difficulties, they may be more prone to adverse emotions. The results of this study show that participation in activities affects anxiety in the long-term care population, which is consistent with previous study (46–48). This may be related to the fact that engaging in activities reduces loneliness among older adults. Severe feelings of loneliness are often associated with negative emotional states and adverse psychological consequences that can lead to various physical and mental health issues, including anxiety (49). In contrast, participation in activities can provide older adults with a sense of presence and fulfillment and reduce feelings of loneliness.

5. Limitations

This study has some limitations that should be noted. Firstly, a retest reliability test was not conducted. Secondly, although the sample size was sufficient for the study, it was not a multi-province study, and the relatively narrow selection process may limit the generalizability of the findings. Therefore, future studies should aim to expand the scope and sample to include a more diverse population to improve the generalizability of the results.

6. Conclusion

This study employed a rigorous process for the translation, back-translation, cross-cultural adaptation, pre-experimentation, reliability, and validity testing of the Chinese version of the Geriatric Anxiety Scale-Long-Term Care. The Geriatric Anxiety Scale-Long-Term Care was successfully introduced into China with good validity and reliability. It is an appropriate measurement tool to quickly assess the anxiety levels of Chinese older adults in need of long-term care and to provide a basis and prerequisite for researchers to develop educational programs and interventions in the context of geriatric caregiver shortage and population aging.

Data availability statement

The datasets presented in this article are not readily available because the datasets generated and/or analyzed during the current study are not publicly available to preserve anonymity of the respondents but are available from the corresponding author on reasonable request. Requests to access the datasets should be directed to 1377533362@qq.com.

Ethics statement

The studies involving humans were approved by Jinzhou Medical University (Ethics approval number: JZMULL2022095). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

FF: Writing – original draft. QC: Writing – review & editing. CZ: Writing – review & editing. HZ: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Health behaviors and problems in Polish homeless men

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Introduction: Homelessness is considered to be a global problem, independent of the material situation of a given country and occurring in most societies around the world.

Aim of the study: Assessment of the preferred health behaviors of homeless people.

Materials and methods: The study covered 153 men who are homeless and 312 men who are not homeless. The original questionnaire of homeless, and validated the Satisfaction with Life Scale (SWLS), the Health Behavior Inventory (HBI), the General Self-Efficacy Scale (GSES) and the Multidimensional Health Locus of Control (MHLC) Scale were used. The research covered fully completed questionnaires from 153 homeless men staying in Białystok and Gdańsk homelss centers.

Results: On average, the homeless men assessed their health at 6.0 ± 2.7 points, and the non-homeless at 7.8 ± 2.2 points ($p < 0.001$). Significant differences were found between people experiencing a homelessness crisis and the control group in selected aspects concerning the everyday life hygiene of the respondents, health self-assessment, declarations of visits to a specialist and carrying out check-ups, level of satisfaction with life, coping with difficult situations, preferred pro-health behaviors and dimensions of health control. In the used scales, SWLS, HBI, GES, and MHCL, the majority of homeless men obtained average scores. They were rather dissatisfied with their lives, with a low level of effectiveness in coping with difficult situations and obstacles, a low level of health behaviors, and in the scope of health, control increasing the impact of chance.

Conclusion: The level of the presented health behaviors showed statistically significant diversification with all dimensions of the health locus of control, and its internal dimension with age, homelessness phase, the respondents' criminal history, being under constant medical care, and self-assessment of health.

KEYWORDS

homeless, health promoting behaviors, men, mental health, Poland health behaviors, health problems, Poland the homeless

Introduction

Homelessness is considered to be a global problem, independent of the material situation of a given country and occurring in most societies around the world. The population of homeless people is internally very diversified, although it is possible to observe in it some life situations typical for this group, most often of a social, economic, psychological, legal or health nature (1). However, the literature on the subject lacks a consensus as to the exact definition of homelessness and a consensus as to whether people living in conditions described as 'homeless' consider themselves as such (2). In general, homelessness is defined as 'the state of a lack of a home' (3), which does not reflect the actual scope of the problem. Homelessness is living without a home and the inability to satisfy basic needs. Therefore, the definition of homelessness should not exclude people living in inadequate housing conditions or temporary accommodation. The UN report, after Brannon (4), distinguishes the following types of homelessness: rough sleeping (sleeping on the street, under a bridge, or in a public place–temporary, seasonal, short-or long-term); living on the sidewalk (use of the 'pitch' and shelter under cardboard, fabric or plastic–short- or medium-term); squatting (regularly staying in the same abandoned building for a short or medium period); living in poor, often unsafe accommodation (on boats or other floating platforms without protection or services, which do not pass all adequacy tests–long-term or permanent) and refugee camps (life without the possibility of returning home–long-term or permanent). Based on ETHEOS 2008, the Polish Typology of Homelessness was developed (5, 6); it distinguishes rooflessness (living without a roof over their head in public spaces), houselessness (staying in facilities for the homeless, in shelters, temporary and transitional accommodation, medical and penitentiary institutions without a residential address); unsecured accommodation (living in unsecured/insecure accommodation temporarily with family/friends); inappropriate/inadequate accommodation (living in temporary/unconventional, fragile constructions/structures – mobile homes, unconventional buildings, temporary structures).

Nearly 155 million people are thought to be homeless and stay in temporary shelters, refugee camps, and other transitional conditions, with another billion living without adequate shelter. It is estimated that by 2050, this number will reach 3 billion. The largest increase in the homelessness rate was recorded in Iceland (by 168% from 2009 to 2017, although the homelessness rate remained low, at 0.1% of the total population). In turn, Norway and Finland recorded the largest decreases in the homelessness rate (in Norway, it fell by 40% in 2012–2016, and in Finland by 39% in 2010–2018). In such countries as Austria, Canada, Denmark, Poland, Slovenia, and Sweden, the homelessness rate has remained relatively stable in recent years (7). In Israel, in 2018–2020, the homeless population almost doubled, from about one person to almost 800 people (7).

At this point, it is worth noting that compared to the countries of Western Europe and other developed countries of the world, where the issue of homelessness has been the subject of systematic reflection in social sciences for many decades, this phenomenon was scientifically diagnosed in Poland very late (8) and it is a problem that is still not fully diagnosed. A relatively new phenomenon in Poland is the increase in the group of homeless foreigners, who often stay illegally, and the so-called 'homeless by choice' who wander from city to city (free birds, 'giants', vagabonds), who reject all applicable norms and consciously remain on the margins of social life (1).

Homelessness is associated with poorer health status and affects men, women, children, and veterans (9).

Several recent studies indicated that 20–31% of homeless adults endorse such alcohol related problems (10, 11). Compared with housed populations, alcoholism, anemia, and growth problems are more common among homeless persons.

In this study, we tried to evaluate the health behaviors in a group of men experiencing a homelessness crisis in Poland.

Health behaviors have been defined as 'overt behavioral patterns, actions, and habits that relate to health maintenance, to health restoration, and to health improvement' (12). A variety of behaviors fall within such a definition, including smoking, alcohol use, diet, physical activity, sexual behaviors, physician visits, medication adherence, screening, and vaccination. Four widely studied health behaviors that are a regular focus of attention are smoking, binge drinking and physical activity (13, 14).

Many health psychology research has examined the psychological determinants of health behaviors (15). Several general models of such determinants have been developed including the health belief model; protection motivation theory, self-determination theory, theory of reasoned action/theory of planned behavior; and social cognitive theory. These models contain several common determinants: intentions, self-efficacy, outcome expectancies, perceived susceptibility, and perceived severity.

Medical anthropology studies how health and illness are shaped, experienced, and understood in the context of cultural, historical, and political forces. Perhaps anthropology's greatest contribution to our knowledge of homelessness has been a description and understanding of the methods of adaptation and survival in life on the streets and in the shelters (16). The thick, ethnographic descriptions of the daily rounds of the homeless have brought the concept of "the street" to life in these studies. As a group, anthropologists see the street (in its full metaphoric sense) as one of the sites for the kinds of adaptations to contemporary life that some homeless people make.

Understanding the experiences, practices, and perceptions of homeless people in health behaviors is essential to perform effective interventions to improve health outcomes. Furthermore, there are few studies on health behaviors in homeless people.

We wanted to explore selected aspects of mental health including health behaviors, self-efficacy, and locus of control in homeless men. The detailed aims included the assessment of selected health behaviors, need for health care and education, life satisfaction, the strength of the general conviction of the respondents as to the effectiveness of coping with difficult situations and obstacles, sense of the health locus of control and the dependence of the above on the phase of homelessness in the group of people experiencing homelessness crisis compared to those who do not experience it.

Materials and methods

The research performance received the consent of the Bioethics Committee, R-I- 449/2013. The main research was preceded by a pilot study in each group of 50 people, which made it possible to verify the clarity of the statements formulated in the questionnaires and to finally develop the original questionnaire. The research covered fully completed questionnaires from 153 homeless men staying in Białystok at the St. Brother Albert Home for the homeless of Caritas of the Archdiocese of Białystok, Men's Night Shelter of Caritas of the Archdiocese of Białystok, Women's Night Shelter of Caritas of the Archdiocese of Białystok, Emergency Help Point of the ELEOS Orthodox Mercy Center of the Białystok-Gdańsk Diocese and 312 people who do not experience a homelessness crisis (control group). The selection of the groups was purposeful, and the research was carried out with the diagnostic survey method with the use of:

Instruments

The original questionnaires (version for the homeless and those who are not homeless) consisting of 40 particular questions and questions concerning various aspects of homelessness was used. This survey was not validated. It consists of three parts.

PART I

1. Gender.
2. Age.
3. Marital status.
4. Do you have any children?
5. If so, do you keep in touch with them?
6. Last place of permanent residence:
7. Last place of work.
8. Education.
9. Have you ever had a criminal record?
10. Do you have an ID card?
11. Do you have permanent registration?
12. What are your current sources of income?
13. Are you ready to start work in the coming days if possible?
14. Do you think it is possible to get out of homelessness?

PART II

1. What phase of homelessness are you in?
2. Why did you become homeless?
3. Please indicate where you have been staying in the last year.
4. Do you have health insurance?
5. Do you have a certified disability group or degree of disability?
6. Do you use social assistance?
7. What forms of social assistance do you use?
8. What social assistance facilities do you know for the homeless?

PART III

1. On a scale of 0 to 10, how would you rate your current health?
2. When were you last hospitalized, and why?
3. How often do you use medical care?
4. Are you under constant medical supervision?
5. How often did you use medical services during the last year?
6. Do you follow the doctor's recommendations?
7. What do you usually do when you feel sick, in pain, or have any ailments?
8. What medications have you used in the last year?*.
9. What are the most important diseases that currently affect you?
10. How often do you have a bath during the week?
11. When you last visited physician or dentist, he had an x-ray of the lungs.
12. How often do you eat the following meals - first breakfast, second breakfast, lunch, afternoon tea, dinner.
13. Do you smoke cigarettes? If so, since when, how much per day, how often.
14. Do you drink alcohol? If so, since when, how much per day, how often.
15. Which ailments do you feel Headaches, Lumbar spine pain, Cervical spine pain, Abdominal pain, Pain in lower limbs, Physical fatigue, Mental fatigue, Susceptibility to stress, Insomnia, Other, what.
16. Do you have any difficulties in performing the following daily activities, such as washing, dressing, moving around, preparing meals.
17. Do you have access to health services?
18. Where is access to health services for the homeless hindered?
19. Which doctor do you have the most difficult access to?

The standardized Satisfaction with Life Scale (SWLS), *Diener, Emmons, Larsen, Griffin, in Polish Juczyński,* version for other professionals who are not psychologists, to assess the extent to which the respondent relates to their current life was used (17). The Satisfaction With Life Scale (SWLS) consists of five statements. The subjects assessed the degree to which the statements describe their lives so far: 1 meant "I strongly disagree," 2 – "I disagree," 3 – "I somewhat disagree," 4 – "I neither agree nor disagree," 5 – "I somewhat agree," 6 – "I agree" and 7 – "I strongly agree." The scores were summed up, and the general result described the level of satisfaction with one's life. The scores could range from 5 to 35 points, where higher values corresponded to higher satisfaction with life: 5–9 points – for a person extremely dissatisfied with his life, 10–14 points – for a person dissatisfied with his life, 15–19 points – a person slightly dissatisfied with his life, 20 points – a person neither satisfied nor dissatisfied with his life, 21–25 points – a person slightly satisfied with his life, 26–30 points – a person satisfied with his life, 31–35 points – a person delighted with his life. In the interpretation of the results, the specificity of the sten scale was also taken into account. 1–4 sten scores were considered low, 7–10 sten scores were considered high, and 5–6 sten scores were considered average. The Cronbach's α values start at 0.86 (15).

The standardized Health Behavior Inventory (HBI) according to Juczyński – containing 24 questions describing various types of health-related behaviors (eating habits, preventive behaviors, positive mental attitudes, health practices) in the last 12 months (17). The answers to these questions were graded using a five-point scale where one corresponds to nearly never and five to nearly always. Based on this point system, the mean level of health behaviors was calculated for each category. The total HBI was calculated as the sum of all points gathered. Theoretically, the total HBI could range from 24 points (all answers graded 1) to 120 points (all answers graded 5). These values are presented and interpreted using the standard 10 scale (women: low 24–77 pts., moderate 78–91 pts., high 92–120 pts.; males: low 24–71 pts., moderate 72–86 pts., high 87–120 pts). Cronbach's reliability index (alpha index) of HBI was calculated to be 0.85, ranging from 0.60 to 0.65 depending on the analyzed category of health behaviors.

The General Self-Efficacy Scale (GSES)–R. Schwarzer, M. Jerusalern, Z. Juczyński–measuring the strength of an individual's general conviction as to the effectiveness of coping with difficult situations and obstacles (17). The respondent chooses one of four possible responses: no –1, rather no - 2, rather yes - 3, yes - 4. The total score presents a general indicator of self-efficacy, which can vary from 10 to 40 points. High scores represent a high sense of self-efficacy. The general indicator was transformed into standardized units and was interpreted according to the characteristics of the sten score. 1–4 sten scores were considered low, 7–10 sten scores were considered high, and 5–6 sten scores were considered average. The Cronbach's α of the scale is high – 0.85.

The Multidimensional Health Locus of Control (MHLC-B) Scale version B of B. Wallston, B. S. Wallston, R. DeVellis, in the Polish adaptation of Juczyński – assessing generalized expectations of the respondents in three dimensions of the health locus of control: internal (conviction that control over my own health depends on me); the impact of others (conviction that the state of my health is the result of the impact of others, mainly medical personnel) and chance (the state of health depends on chance or other external factors). The results obtained allow the classification of the respondents into the following types: Strong Internal, Strong External, Decreasing the Impact of Others; Increasing the Impact of Others; Decreasing the Impact of Chance; Increasing the Impact of Chance, Undifferentiated-Strong and Undifferentiated-Weak (17).

Statistical analysis

The Statistica 13.0 PL program was used for statistical calculations. The Chi2 test was used to compare response rates between groups. Statistical relationships between satisfaction with life, health behaviors, coping with difficult situations and dimensions of the health locus of control in the surveyed group of homeless men and age, phase of homelessness and criminal record calculated with the use of multiple regression analysis. Statistical significance was evaluated at $p < 0.05$.

Characteristics of the study group

In the study group of 153 homeless men, the largest number was in the age range from 51 to 60 (36.6%), divorced men (55.5%), having children (59.5%), but not maintaining contact with them (53.6%). Most frequently, the respondents had a permanent address of residence in a city with a population over 200,000 (59.6%) and vocational education (52.3%), Details are shown in Table 1.

Results

The most common reasons for homelessness were eviction, residence address deregistration (41.8%), family conflicts (30.7%), unemployment, lack of work and lack of sources of income (22.2). Details are shown in Table 2.

The respondents indicated numerous social welfare facilities for the homeless, including night shelters (65.9%), warming centers (44.4%), and other shelters (people – 36.6%).

In the next part of the study, the health habits of the respondents were assessed. 92.2% of the surveyed homeless people and none of the men from the control group did not wash every day. The largest number of the homeless and men from the control group declared that they eat lunch (71.2 and 64.7% respectively) and dinner (77.1 and 58.3% respectively) every day. More than half (55%) of homeless drunk alcohol. Details are shown in Table 3.

The respondents were asked to rate their health from 0 to 10 on a scale. Most frequently, the homeless chose 5 points in their health self-assessment (33 people–21.6%), and men from the control group chose 7 points (23.3%). The homeless men assessed their health poorer (6.0 ± 2.7 points) than the non-homeless (7.8 ± 2.2 points) ($p < 0.001$).

In the homeless group, 98 (64.1%) and 312 (91.0%) in the control group did not have a disability degree certificate.

The respondents declared that:

- they use professional medical assistance when necessary: the homeless–60 (39.2%) and the non-homeless – 80 (25.6%)–$p = 0.030$
- they did not use it at all: the homeless–39 (25.5%) and the non-homeless–10 (3.2%)–($p < 0.001$)
- several times a year: the homeless–12 (7.8%) and the non-homeless–62 (19.9%)–$p = 0.005$
- several times a month: the homeless–7 people (4.6%) and the non-homeless–32 (10.3%)–NS

In a situation where they feel pain, any ailments:

- they immediately went to the doctor and used medicines prescribed by them–49 (32%) homeless people and 130 (41.7%) men from the NS control group
- they only used their own tested methods – 48 (31.4%) homeless people and 72 (23.1%) men from the NS control group
- they did nothing and tried to wait out the ailments–28 (18.3%) homeless people and 50 (16%) men from the NS control group
- they did not go to the doctor because they could not afford it–25 (16.3%) homeless people and 20 (6.4%) men from the control group $p = 0.004$
- 3 (2%) homeless people and 40 (12.8%) men from the control group had problems with the declaration on this issue $p < 0.001$

21 (13.7%) homeless people and 214 (68.6%) people from the control group ($p < 0.001$) used the help of the general practitioner.

In the last year, 48 (31.4%) surveyed homeless men and 70 (22.4%) from the control group did not use medical assistance–NS.

In the last year, 62 (40.5%) surveyed homeless men and 284 (91%) from the control group were not in hospital–$p < 0.001$.

In the last year they took antibiotics–50 (32.7%) homeless men and 139 (44.6%) from the control group–NS; vitamins–47 (30.7%) homeless men and 176 (56.4%) from the control group–$p = 0.0019$, analgesics–33 (21.6%) homeless men and 11 (3.5%) from the control group–$p < 0.001$; sedatives–31 (20.3%) homeless men and 36 (11.5%) from the control group–$p = 0.034$. No medications were taken by 34 (22.2%) homeless men and 56 (17.9%) from the control group–NS.

TABLE 1 Characteristics of the study group.

	Number of men/percentage			
Data	Homeless $n = 153$		Not homeless $N = 312$	
Age				
<20 years old	3	1.9%	0	0%
21–30 years old	13	8.5%	58	18.6%
31–40 years old	28	18.3%	92	29.5%
41–50 years old	25	16.3%	64	20.5%
51–60 years old	56	36.6%	72	23.1%
61–70 years old	25	16.3%	14	4.5%
>70 years old	3	1.3%	12	3.8%
Permanent residential address				
City with a population over 200,000	91	59.6%	140	44.9%
City with a population of 50,000-200,000	30	19.6%	50	16.0%
City with a population below 50,000	16	10.5%	58	18.6%
Rural	13	8.5%	64	20.5%
Education				
Master’s degree	10	6.5%	116	37.2
Bachelor’s degree	0	0	92	29.5%
Secondary education	48	31.4%	58	18.6%
Vocational education	80	52.3%	46	14.7%
Primary education	3	1.9%	0	0
No data	12	7.8%	0	0
Marital status				
Married	17	11.1%	162	51.9%
Widower	13	8.5%	62	19.9%
Single	49	32.0%	58	18.6%
Divorced	68	55.5%	18	5.8%
Separated	3	2.0%	12	3.8%
No data	3	2.0%	0	0%
With children				
Yes	91	59.5%	240	76.9%
Maintaining contact	71	78.0%	240	76.9%
Lack of contact	20	22.0%	0	0%
No	62	40.5%	72	23.1%
Last employment				
Job in a state-owned company	79	51.6%	200	64.1%
Job in a private company	29	19.0%	112	35.9%
Person who has never worked	1	0.7%	0	0
Source of income				
No income	38	24.8%	0	0%
Social benefit	54	35.3%	0	0%
Disability pension	3	3.9%	38	12.2%
Pension	6	3.9%	40	12.8%
Begging	3	2.0%	0	0%
Gathering	9	5.9%	0	0%

(Continued)

TABLE 1 (Continued)

	Number of men/percentage			
Data	Homeless $n = 153$		Not homeless $N = 312$	
Undeclared work	14	9.2%	0	0%
Intervention works	8	5.3%	0	0%
Occasional work	1	0.7%	0	0%
Recycling	8	5.3%	0	0%
Family help	6	3.9%	60	19.2%
Full-time job	0	0	122	39.1%
Scholarship	0	0	50	16%
Criminal record				
No	75	49.1%	0	0
Yes	78	50.9%	312	100%
Having an ID card				
No	19	12.4%	0	0
Yes	134	87.6%	312	100%
Having a permanent address				
Yes	36	23.5%	312	100%
No	109	71.2%	0	0
Once yes	8	5.3%	0	0

During the study, 74 (48.4%) homeless men and 112 (35.9%) from the control group reported they did not suffer from any disorders. Others most often complained about hypertension–14 (9.2%) homeless men and 116 (37.1%) from the control group–$p < 0.001$; back pain–10 (6.5%) homeless men and 18 (5.8%) from the control group–NS, asthma/allergy–8 (5.2%) homeless men and 48 (15.4%) from the control group–$p = 0.007$, heart problems–6 (3.9%) and 34 (10.9%) from the control group $p = 0.031$, diabetes–5 (3.3%) homeless men and 41 from the control group $p < 0.001$, epilepsy, gastric ulcer–4 (2.6%) homeless men alcoholism. In the control group, anemia was also reported–4 (1.3%) people, headaches/migraine–18 (5.8%) people, thyroid diseases–18 (5.8%) people, ophthalmological diseases–21 (6.7%) people, joint degeneration–19 (6.1%) people and lower limb varicose veins–6 (1.9%) people.

The respondents were asked about the declaration of visits for the internist, dentist and lung x-rays. Most often, the homeless claimed that they did not remember the last time they had visited an internist (53.6%), dentist (52.3%) and when they had a lung x-ray (51%). Details are shown in Table 4.

Homeless men reported, sometimes they have a headache (34%), stomachache (32.7%), physical fatigue (36.6%), mental fatigue (34. 6%), stress (33.3%), insomnia (32%), and, every day, lower back pain (30.7%), and lower limb pain (36.6%). Men from the control group most often had a headache (39.1%), stomachache (31.4%), mental fatigue (33.3%), stress (35.9%), insomnia (42.9%), lower back pain (42.9%), lower limb pain (40.4%), neck pain (37.8%), and, every day, physical fatigue (30.1%). The results are shown in Table 5.

In the assessment of satisfaction with life (SWLS), the homeless men obtained 15.4 ± 8.1 points on average (people rather dissatisfied with their lives), and in the control group – 23.2 ± 5.5 on average (people rather satisfied with their lives). In assessing the effectiveness of coping with difficult situations and obstacles, the homeless men obtained 18.5 ± 5.7 points, and the control group obtained 29.1 ± 1.2 points. The homeless in the point scale in the assessment of health behaviors (HBI) obtained 62.4 ± 21.9 points on average, and the control group obtained 82.1 ± 10.8 points. The homeless obtained the highest average values for positive mental attitude (2.9 ± 1.1 points on average), and the control group for health practices (3.9 ± 0.7). The homeless and the control group obtained the lowest mean values for proper eating habits (2.3 ± 1.0 and 3.5 ± 0.9, respectively). In assessing the dimensions of the health locus of control, the homeless obtained the highest average values in the dimension of chance – 19.2 ± 9.1 points on average, and the control group in the internal dimension (26.0 ± 5.2). Details are shown in Table 6.

Statistically significant correlations were found between the internal dimension of health behavior control and age, homelessness phase, criminal history of the respondents, being under constant medical care and health self-assessment. The 'Impact of others' dimension showed significant statistical differences with the level of health behaviors, and the 'chance' dimension with the criminal record of the respondents. The level of the presented health behaviors showed statistically significant differences with all dimensions of the health locus of control (Table 7).

Discussion

In the present study, health behaviors of homeless men showed statistically significant diversification with all dimensions of the health locus of, and its internal dimension with age, homelessness phase, the respondents' criminal history, being under constant medical care, and self-assessment of health. We found significant differences between the homeless men and controls in selected aspects concerning the everyday life hygiene, health self-assessment,

TABLE 2 Selected aspects of homelessness in the group of respondents.

Problem	Number of people *N* = 153		Problem	Number of people *N* = 153	
Causes of homelessness*			Place of last residence*		
Eviction, deregistration	64	41.8%	Shelter	38	24.8%
Family conflicts	47	30.7%	Night shelter	45	29.4%
Alcohol	5	3.3%	Warming center	53	34.6%
Gambling	7	4.6%	Staircase	12	7.8%
Domestic violence	5	3.3%	Gazebos, allotment buildings	17	11.1%
Debt	4	2.6%	Basements	6	3.9%
Unemployment, lack of work or other sources of income	34	22.2%	Being put up by family or friends	16	10.5%
Leaving prison	7	4.6%	Attics	4	2.6%
Poor health status	5	3.3%	Park	5	3.3%
Conflicts due to a lack of social tolerance	8	5.2%	Stations, wagons, railway sidings	1	0.7%
Disability	4	2.6%	Heating pipes and nodes	1	0.7%
Own free choice	9	5.6%	Caritas facility	8	5.2%
Nervous breakdown	1	0.7%	Vacant buildings	6	3.9%
Divorce	3	2.0%	Forest	1	0.7%
Depression	1	0.7%	Penal institution	2	1.4%
Apartment fire and lack of a substitute apartment	1	0.7%	Center helping to leave homelessness	2	1.4%
Death of both parents	1	0.7%	Den	7	4.6%
Children moving abroad	1	0.7%	Monar	1	0.7%
Arrest	1	0.7%	No answer	11	7.2%
Sale of an apartment	1	0.7%	Having health insurance		
Helplessness	1	0.7%	Yes	23	15.0%
Home burglary	1	0.7%	No	128	86.7%
Own decision	2	1.4%	Not sure	2	1.4%
Accident at work	2	1.4%	Using social assistance		
No light in the apartment	1	0.7%	Yes	101	66.0%
No water in the apartment	1	0.7%	No	52	34.0%
No data	8	5.2%	Forms of social assistance*		
Phase of homelessness			I do not use it	52	34.0%
0–1	35	22.9%	Financial assistance	81	52.9%
1 to 2 years	9	5.6%	Meal	44	28.8%
2 to 4 years	41	26.8%	Shelter	43	28.1%
4 to 6 years	14	9.2%	Clothes	17	11.1%
6 to 10 years	21	13.7%	Food	18	11.8%
over 10 years	24	15.7%	Food parcels	3	2.0%
No data	9	5.6%	Stay in a shelter	3	2.0%
Is it possible to exit homelessness?			Benefit	1	0.7%
No	11	7.2%			
Yes	114	74.5%			
Hard to say	28	18.3%			

*Multiple answers possible.

declarations of visits to a specialist and carrying out check-ups, level of satisfaction with life, coping with difficult situations, preferred pro-health behaviors and dimensions of health control.

In the study by Baranowski (18), which covered 91 homeless people, 80.2% were men and people aged 51 to 60 (37.4%) and 41 to 50 (34.1%). This was confirmed by research conducted by Pindral (7),

TABLE 3 **Selected aspects concerning the everyday life hygiene of the respondents.**

Problem		Number of men/percentage				P value
		Homeless $n = 153$		Not homeless $N = 312$		
Washing/bathing						
Daily washing	No	141	92.2%	0	0%	**<0.001**
	Yes	9	5.9%	312	100%	**<0.001**
	It varies	3	1.9%	0	0%	NS
Frequency of bathing during a week	At all	17	11.1%	0	0%	**<0.001**
	Once	19	12.4%	24	7.7%	NS
	2–3 times	44	28.8%	10	3.2%	**<0.001**
	More than 3 times	2	1.3%	92	29.5%	**<0.001**
	Every day	9	5.9%	146	46.8%	**<0.001**
	It varies	62	40.5%	0	0%	**<0.001**
Eating meals						
1st breakfast	Every day	13	8.5%	164	52.6%	**<0.001**
	Occasionally	109	71.2%	104	33.3%	NS
	At all	31	20.2%	44	14.1%	NS
2nd breakfast	Every day	41	26.8%	114	36.5%	**<0.001**
	Occasionally	31	20.2%	126	40.4%	**<0.001**
	At all	81	53.0%	72	23.1%	NS
Lunch	Every day	109	71.2%	202	58.3%	NS
	Occasionally	22	14.4%	60	19.2%	NS
	At all	22	14.4%	50	16.0%	NS
Afternoon snack	Every day	36	23.5%	80	25.6%	NS
	Occasionally	17	11.1%	100	32.1%	**<0.001**
	At all	100	65.4%	132	42.3%	NS
Dinner	Every day	118	77.1%	182	58.3%	NS
	Occasionally	17	11.1%	72	23.1%	**0.019**
	At all	18	11.8%	58	18.6%	NS
Smoking						
Smoking declaration	No	26	17.0%	14	4.5%	NS
	Now not before yes	9	5.9%	60	19.1%	**<0.001**
	Occasionally	11	7.2%	42	13.5%	NS
	Yes	107	69.9%	196	62.8%	NS
Average smoking period	28.2 ± 12.2; (4 – 50 years)			18.9 ± 6.5; (1–35 years)		
Alcohol consumption						
Alcohol consumption declaration	No	25	16.3%	96	30.8%	**0.012**
	Now not before yes	35	22.9%	12	3.8%	**<0.001**
	Yes	93	60.8%	32	10.3%	**<0.001**
	Do not drink	60	39.2%	108	34.6%	NS
Frequency of alcohol consumption	Every day	33	21.6%	20	6.4%	NS
	Once a week	17	11.1%	24	7.7%	NS
	Several times a month	22	14.4%	66	21.2%	NS
	Several times a year	21	13.7%	94	30.1%	0.003
Daily alcohol consumption	380.3 mL ± 247.2 mL; Min. 100 mL; Max. 660 mL			120.6 mL ± 80.4 mL Min. 25 mL; max. 500 mL		
Type of alcohol	Do not drink	60	39.2%	108	34.6%	NS
	Beer	73	47.7%	50	16.0%	NS
	Wine	25	16.3%	128	41.0%	**<0.001**
	Vodka	35	22.9%	116	37.2%	**0.031**
	Whatever	22	14.4%	0	0%	**<0.001**

Chi-square test. Bold letters for significant values.

TABLE 4 Declaration of visits to the internist, the dentist, and for a lung X-ray.

		Number of men/percentage				*P*–value
Problem		Homeless *N* = 153		Not homeless *N* = 312		
Last visit to the internist	1–2 months ago	35	22.9%	66	21.2%	NS
	Half a year ago	11	7.2%	84	26.9%	**<0.001**
	1 year ago	9	5.9%	64	20.5%	**<0.001**
	Several years ago	16	10.5%	36	11.5%	NS
	I do not remember	82	53.6%	62	19.9%	NS
Last visit to the dentist	1–2 months ago	16	10.5%	118	37.8%	**<0.001**
	Half a year ago	5	3.3%	94	30.1%	**<0.001**
	1 year ago	23	15.0%	10	3.2%	NS
	Several years ago	29	19.0%	28	9.0%	NS
	I do not remember	80	52.3%	62	19.9%	NS
Last lung X-ray	1–2 months ago	14	9.2%	2	0.6%	**<0.001**
	Half a year ago	9	5.9%	6	1.9%	NS
	1 year ago	18	11.8%	34	10.9%	NS
	Several years ago	34	22.2%	10	3.2%	**<0.001**
	I do not remember	78	51.0%	260	83.3%	**<0.001**

Chi-square test; NS, not significant. Bold letters for significant values.

which also showed a much higher percentage of men in the homeless group (on average four times); research conducted by Śledzianowski (19)–in which he also found the dominance of men (90.7%) and the research from 2019, in which it was shown that the largest number of homeless people were aged 41–60 (45.5% of people) (20). The above was also confirmed in the current study, in which the largest number, i.e., 36.6%, of men were in the age range from 51 to 60.

In the study by Baranowski (18), 46.2% of the homeless declared vocational education, 24.1%–primary or incomplete primary education, 17.6%–secondary education, 7.7%–general secondary education, and 2.2%–lower secondary education or higher education. In the group Pindral [7] studied, 75% of homeless people had post-primary education, a 34% higher indicator than the homeless population. In the study by Śledzianowski (19), 50.8% of homeless people had vocational education, 23.5% had primary education, 21.2% had secondary or incomplete secondary education, and 3.9% had higher education.

The literature data show that the homeless population is also dominated by singles, divorcees, people in separation, children, and wives fleeing from home due to violence by their fathers or husbands (20). The homeless people in the 2011 study in Białystok, Suwałki (21) were most often (44%) divorcees; almost 30% of the respondents were unmarried, 15%–married, and 10% were widowed. This has been confirmed in the current study, where divorced people accounted for 55.5% of all homeless people and singles for 32%.

In the literature on homelessness (22, 23), there are certain levels of isolation of the homeless which make it difficult to get out of homelessness: economic level (failure to meet needs), social level (lack of interpersonal relationships), individual level (emotional disorders, low self-esteem) and institutional level (confusion in institutional support mechanisms). In the research of Baranowski (11), the most frequently indicated factors causing homelessness were family problems (42.9%) and addictions (41.8%). Inhabitants of Łódź studied by Bartczak et al. (22) indicated addictions (86.5%), eviction from the apartment (78.6%), and loss of a job (62.0%) or being abandoned by the closest family (48.1%) as reasons for becoming homeless. According to a 2019 study, the main cause of homelessness was family conflict (32.2%), addiction (28%), eviction, deregistration (26.3%) and relationship breakdown (18.4%) (22). This has also been confirmed in our research because, in the case of our respondents, the homelessness crisis was most often caused by eviction, deregistration (41.8%), and family conflicts (30.7%).

In the research by Baranowski (18), 62.6% of the homeless stayed in various institutions such as hostels, centers for the homeless, or social emergency centers, while the remaining 37.4% occasionally used the offers of eateries and came to various centers for food and clothes. The homeless surveyed by Olech (24), rarely used the services of facilities providing them with shelter, and during the last year, only 7% occasionally lived in a facility for homeless people. According to the 2019 study, 80.2% of the homeless stayed in institutional facilities, such as shelters, while the remaining 19.8% lived outside (20). Contrary to the above data, in the present study, only 24.8% indicated a shelter as the place of their last stay; the respondents most often indicated warming centers (34.6%) and night shelters (29.4%).

In the literature (21, 24, 25), there is a division of the typology of homeless people into homeless by choice, homeless by force, actually homeless at risk of homelessness, homeless by force, temporarily homeless by choice; shallowly homeless deeply homeless and permanently homeless temporarily homeless. Also (26) five stages of homelessness are distinguished: 1. breakdown of the life plan and breakdown of the family; 2. material poverty, cultural poverty, and social poverty; 3. different dimensions of becoming homeless; 4. adaptation to homelessness; 5. actual, chronic homelessness, when full adaptation to the state of homelessness takes place, lasting 6 to 10 years. The largest group in the 2019 study was people experiencing a homelessness crisis for more than 5 to 10 years–(27.8%) and

TABLE 5 Declaration of the frequency of experiencing selected ailments.

Health problem		Number of men/percentage				*P*–value
		Homeless $n = 153$		Not homeless $N = 312$		
Headaches	Every day	32	20.9%	52	16.7%	NS
	Once a week	19	12.4%	48	15.4%	NS
	Several times a month	22	14.4%	46	14.7%	NS
	Sometimes	52	34.0%	122	39.1%	NS
	Never	28	18.3%	44	14.1%	NS
Lower back pain	Every day	47	30.7%	40	12.8%	NS
	Once a week	17	11.1%	48	15.4%	NS
	Several times a month	20	13.1%	32	10.3%	NS
	Sometimes	42	27.5%	134	42.9%	**0.033**
	Never	27	17.6%	58	18.6%	NS
Neck pain	Every day	37	24.2%	46	14.7%	NS
	Once a week	17	11.1%	26	8.3%	NS
	Several times a month	19	12.4%	50	16.0%	NS
	Sometimes	36	23.5%	118	37.8%	**0.037**
	Never	44	28.8%	72	23.1%	NS
Stomachache	Every day	29	19.0%	24	7.7%	NS
	Once a week	19	12.4%	14	4.5%	NS
	Several times a month	22	14.4%	42	13.5%	NS
	Sometimes	50	32.7%	98	31.4%	NS
	Never	33	21.6%	52	16.7%	NS
Lower limb pain	Every day	56	36.6%	44	14.1%	NS
	Once a week	15	9.8%	28	9.0%	NS
	Several times a month	19	12.4%	22	7.1%	NS
	Sometimes	40	26.1%	126	40.4%	**0.043**
	Never	23	15.0%	92	29.5%	**0.009**
Physical fatigue	Every day	40	26.1%	94	30.1%	NS
	Once a week	17	11.1%	50	16.0%	NS
	Several times a month	28	18.3%	42	13.5%	NS
	Sometimes	56	36.6%	86	27.6%	NS
	Never	12	7.8%	40	12.8%	NS
Mental fatigue	Every day	35	22.9%	68	21.8%	NS
	Once a week	20	13.1%	26	8.3%	NS
	Several times a month	30	19.6%	60	19.2%	NS
	Sometimes	53	34.6%	104	33.3%	NS
	Never	15	9.8%	54	17.3%	NS
Feeling stressed	Every day	31	20.3%	22	7.1%	NS
	Once a week	20	13.1%	32	10.3%	NS
	Several times a month	25	16.3%	58	18.6%	NS
	Sometimes	51	33.3%	112	35.9%	NS
	Never	26	17.0%	88	28.2%	0.048
Insomnia	Every day	39	25.5%	26	8.3%	NS
	Once a week	19	12.4%	32	10.3%	NS
	Several times a month	25	16.3%	18	5.8%	NS
	Sometimes	49	32.0%	134	42.9%	**<0.001**
	Never	21	13.7%	102	32.7%	**<0.001**

Chi-square test; NS, not significant. Bold letters for significant values.

TABLE 6 **Results of the analysis using SWLS, GSES, HBI and MHCL-B scales.**

	Number of men/percentage				*p*
	Homeless *n* = 153		Not homeless *N* = 312		
SWLS–level of satisfaction with life					
Average values–points	15.4 ± 8.1		23.2 ± 5.5		**<0.001**
Average level of satisfaction with life–sten scores	3.8 ± 2.7		7.1 ± 1.2		**<0.001**
Person definitely dissatisfied with life	39	25.5%	26	8.3%	NS
Person very dissatisfied with life	40	26.1%	12	3.8%	**<0.001**
Person rather dissatisfied with life	24	15.7%	30	9.6%	NS
Person neither satisfied nor dissatisfied with life	7	4.6%	4	1.3%	NS
Person rather satisfied with life	25	16.3%	112	35.9%	**0.001**
Person very satisfied with life	12	7.8%	76	24.4%	**0.005**
Person definitely satisfied with life	6	3.9%	52	16.7%	**<0.001**
GSES–sense of self-efficacy					
Average values–points	18.5 ± 5.7		29.1 ± 1.2		**<0.001**
Average values–sten scores	2.7 ± 1.8		5.3 ± 2.1		**<0.001**
Low sense	129	84.3%	41	13.1%	**<0.001**
Average sense	13	8.5%	55	17.6%	**0.031**
high sense	11	7.2%	216	69.3%	**<0.001**
HBI–Health Behavior Inventory					
Average value of the general HBI indicator	62.4 ± 21.9		82.1 ± 10.8		**<0.001**
Medium sten scores	3.7 ± 2.3		6.4 ± 1.8		**<0.001**
Correct eating habits	2.3.0 ± 1.0		3.5 ± 0.9		**<0.001**
Preventive behaviors	2.7 ± 1.1		3.8 ± 0.8		**<0.001**
Positive mental attitude	2.9 ± 1.1		3.6 ± 0.7		**<0.001**
Health practices	2.6 ± 0.9		3.9 ± 0.7		**<0.001**
Level of health-related behavior					
Low indicator of the intensity of health behaviors	103	67.3%	103	33.0%	NS
High indicator of the intensity of health behaviors	20	13.1%	131	42.0%	**<0.001**
Average indicator of the intensity of health behaviors	30	19.6%	78	25%	NS
MHCL-B–health control dimension					
Internal (I)	17.9 ± 9.9		26.0 ± 5.2		**<0.001**
Impact of others (IO)	17.7 ± 9.7		19.8 ± 4.9		**0.001**
Chance (CH)	19.2 ± 9.1		24.1 ± 6.8		**<0.001**
Strong internal type	2	1.3%	48	15.4%	**<0.001**
Strong external type	15	9.8%	44	14.1%	NS
Decreasing the impact of others type	13	8.5%	20	6.4%	NS
Increasing the impact of others type	9	5.9%	24	7.7%	NS
Decreasing the impact of chance type	5	3.3%	28	9.0%	**0.049**
Increasing the impact of chance type	12	7.8%	40	12.8%	NS
Undifferentiated-strong type	50	32.7%	84	26.9%	NS
Undifferentiated-weak type	47	30.7%	24	7.7%	NS

Chi-square test; NS, not significant. Bold letters for significant values.

TABLE 7 Statistical relationships between satisfaction with life, health behaviors, coping with difficult situations and dimensions of the health locus of control in the surveyed group of the homeless and age, homelessness phase and criminal record.

		SWLS	GSES	HBI	MHCL/ DIMENSIONS		
					I	IO	CH
SWLS		1.00	0.268	0.669	0.111	0.791	0.622
GSES		0.268	1.00	0.261	0.349	0.303	0.428
HBI		0.669	0.069	1.00	**0.019**	**0.002**	0.261
MHCL/ Dimensions	I	0.077	0.244	**<0.001**	1.00	1.00	1.00
	IO	0.367	0.186	**<0.001**	1.00	1.00	1.00
	CH	0.714	0.997	**<0.001**	1.00	1.00	1.00
Age		0.128	0.753	0.370	0.002	0.657	0.054
Phase of homelessness		0.213	0.283	0.160	0.001	0.916	0.347
Criminal record		0.057	0.128	0.116	**<0.001**	0.206	0.005
Being under medical care		0.401	0.512	0.477	**0.004**	0.311	0.751
Health self-assessment		0.139	0.326	0.324	**0.001**	0.714	0.163

Multiple regression analysis. Bold letters for significant values.

homeless people for up to 2 years (23.4%) (20). In the current study, there were significantly more homeless people in the phase up to years (28.5%) and fewer in the group from 5 to 10 (21.9%). In the study of Baranowski (18) only 8.8% of homeless persons had a permanent legal job,

The main sources of income for the others were: occasional work (15.4% each), social assistance (12.1%), charitable organizations' assistance (8.8%), disability pension/pension (17.6%), and collecting and selling scrap (5.5%).

Buciński et al. (26) emphasize that the health condition of homeless people is worse than that of the community leading a normal life, and the above depends on many factors and does not allow the treatment of homeless people in a universal way. Basically, the health problem of the homeless is affected by age, length of homelessness, place of stay of the homeless person, aging of the homeless community, and staying in public spaces that increase the risk to health and even life. The issue of homeless people's health should be of key importance for social policy and the system of helping homeless people.

People without a roof over their heads, more often than others, do not have health insurance or an ID card (27). In the research carried out by Śledzianowski (19), 78.7% of women and 60.3% of men had health insurance. The current studies have also confirmed this, as most (86.7%) of our respondents did not have health insurance.

In the study of Śledzianowski (19), 28.7% had a disability degree certificate, usually moderate (64%). In the group of homeless people from the study conducted in 2011 in Białystok, Suwałki (21), 47% had a moderate disability degree, and 30% had a light disability degree. In contrast to the above, in the current study, 64.1% of homeless people did not have a disability certificate.

Heszen (28) emphasizes that health consists of four main dimensions: mental, social, somatic, and spiritual. In the context of homelessness, every aspect of health is important. 77.4% of homeless people from the Śledzianowski study (19) reported good health. In the current study, the respondents assessed their health as average.

The assessment of the health of the homeless in a shelter in Poznań city (29), showed that the most common diseases they had were parasitic and infectious skin diseases, alcoholism, tuberculosis, hypertension, diseases of the spine and musculoskeletal system, nervous system, and gastrointestinal tract. According to the study (21) conducted in 2011 in Białystok, Suwałki, 50% of the homeless reported feeling unhealthy. In the present study, 48.4% of the homeless claimed they did not suffer from any disorders.

While examining the health of the homeless in a shelter for homeless men in Poznań, Przymeński (29) stated that the homeless usually did not treat their diseases. Śledzianowski (19) demonstrated that 57.1% of the homeless people used medical services last year. In the current study, 31.4% of the respondents did not use medical assistance in the last year.

Przymeński (29) closely connects the poor health of the homeless to their living conditions, including poor hygiene, malnutrition, lack of adequate protection against low temperatures, constant stress, lack of satisfaction with basic mental and emotional needs, and addiction to drugs and alcohol. According to Tędzialgolska et al. (30), the daily functioning of homeless people was hindered by the lack of possibility to care for hygiene due to the lack of intimacy, basic toiletries, access to water, and clean clothes. This is also confirmed by our research, because as many as 92.2% of the respondents did not wash every day.

Błażej and Bartosz (26) think that excessive alcohol consumption is a very special feature of homeless people. In a Polish study (24), about 70–80% of adult homeless men are addicted to alcohol. In a French study (31), one in five homeless people was alcohol-dependent. In the current study, the respondents reported that they most often consume alcohol occasionally (55.5%).

Doctors who care for homeless people notice the following health problems: cardiological problems, the digestive, respiratory, urinary, and hormonal systems, cancers, skin diseases, frostbite, dental deficiencies, and HIV/AIDS (24, 32). In the study by Śledzianowski (19), 16.4% of the homeless suffered from congenital diseases, 3.5% from respiratory diseases, 3.3% from mental and neurological diseases, 2.7% from heart and circulatory system diseases, and 3% from musculoskeletal system diseases. In the current research, the respondents most often complained about hypertension (9.2%), back pain (6.5%), asthma (5.2%), heart problems (3.9%), diabetes, colds, pneumonia (3.3% each), epilepsy, gastric ulcer (2.6% each), alcoholism, prostatic hypertrophy, atherosclerosis, and hernia (2% each).

Homelessness brings such emotional effects as loneliness, powerlessness, fear, and anxiety (26, 33). On the other hand, 63.2% of the homeless people from the Śledzianowski study (19) believed they were valuable, and 61.5% did not lose self-confidence. Homeless people from the study by Bodys-Cupak et al. (34) declared a sense of external control over their health and a low sense of effectiveness. Similarly, in the current study, homeless people showed a low level of effectiveness in coping with difficult situations and obstacles but a high level of internal control, indicating the belief that control over their health lies with them. Unfortunately, the homeless respondents also showed a low level of satisfaction with life and a low level of health behaviors, the highest for the sphere of a positive mental attitude and the lowest for proper eating habits.

In conclusion, it is worth emphasizing once again that the problem of homelessness is a broad and extremely complicated phenomenon (35–37). The struggle for survival and the necessity to satisfy basic needs preclude focusing on one's health and taking care of its good condition and often contributes to its deterioration. Therefore, several actions should be taken to protect health. Unfortunately, health for people in the homeless crisis is no longer a value and a determinant of action; hence, problems may arise in complying with the basic principles of treatment and in remission diseases. However, in the current study, as many as 60.1% of the respondents claimed that they always follow medical recommendations, 39.2% did it sometimes or never, and 74.5% were not under constant medical care. The above shows that medical assistance for the homeless requires considering several different variables, including the entire social context. Our results suggest that the groups of men whom special measures should cover are those in the homelessness phase up to 4 years and people with a criminal record.

Study limitations

The small size of the group and the lack of evaluation in the group of women can be considered as limitations of the study.

Practical implications

Homeless people should be provided with free health care.

Homeless people should have access to specialist doctors.

It is advisable to monitor the health behaviors of the homeless to get to know them better.

Future research directions

The research should be carried out on a larger population in different country regions.

Research should also include homeless women.

Conclusion

1. The level of the health behaviors showed statistically significant diversification with all dimensions of the health locus of control and its internal dimension with age, phase of homelessness, criminal history of the respondents, being under constant medical care, and self-assessment of health.
2. Significant differences were found between people experiencing a homelessness crisis and the control group in selected aspects concerning the everyday life hygiene of the respondents, health self-assessment, declarations of visits to a specialist and carrying out check-ups, level of satisfaction with life, coping with difficult situations, preferred pro-health behaviors and dimensions of health control.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without under reservation.

Ethics statement

The studies involving humans were approved by the Bioethics Committee of the Medical University of Bialystok, R-I- 449/2013. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

BR, DC, MZ, AM, AS, and AŚ collected the epidemiological and clinical data. NW processed statistical data. BR, GB, and AK-B drafted the manuscript. BR, GB, and NW revised the final manuscript. WK and EK-K is responsible for summarizing all epidemiological and clinical data. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Dual burden of chronic physical conditions and mental disorders: Findings from the Saudi National Mental Health Survey

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Introduction: Comorbidities of mental disorders and chronic physical conditions are a common medical burden reported among Western countries. National estimates of such comorbidities among the general population of Arab countries like Saudi Arabia are unknown. This study examined the prevalence of lifetime chronic physical conditions among the Saudi general population with DSM-IV 12-month mental disorders, and the associations with disability in the Kingdom of Saudi Arabia (KSA).

Methods: The Saudi National Mental Health Survey, a cross-sectional household study – part of the World Mental Health (WMH) Survey Consortium – was conducted between 2013–2016 in the KSA, with 4,001 Saudi citizens aged 15–65 (response rate 61%). The World Health Organization Composite International Diagnostic Interview 3.0 was used to assess prevalence of lifetime chronic physical conditions and 12-month mental disorders; disability was measured in terms of days out of role.

Results: The prevalence of any comorbid 12-month mental disorder among those with chronic physical conditions was 24%. Major depressive disorder, social phobia, and adult separation anxiety disorder were the most common comorbid mental disorders across all chronic physical conditions. Gender, education, income, urbanicity, region, and employment were associated with the presence of any chronic physical condition. Respondents with mental / physical comorbidities had 2.97 days out of role (on average) in the last 30 days.

Conclusion: Comorbidities of mental disorders and chronic physical conditions are common among Saudis. National efforts are needed to increase awareness of such comorbidities among the general population, and develop prevention and treatment services tailored to the needs of individuals at-risk for comorbidities.

KEYWORDS

comorbidity, chronic physical conditions, mental disorders, Saudi Arabia, disability

1 Introduction

Medical comorbidity is a substantial and common societal burden, posing important challenges in terms of proper identification, prevention, and management strategies on the personal, clinical, and societal level. Comorbidity is usually defined as the presence of one or more additional diseases in a person diagnosed with an index-disease, i.e., a physical or mental condition (1, 2). However, such a co-presence does not imply that one disease is more central or severe than the other (3). Comorbidities between mental and physical disorders are commonly prevalent among general populations globally, regardless of the chronological order of onset, or the causal pathway linking the conditions (2, 4). For instance, individuals with chronic physical conditions are reported to have a higher prevalence of mental disorders than those without chronic physical conditions (2); the physical conditions were also more chronic when a mental disorder was present (5). The New Zealand Mental Health Survey found mental disorders among nearly 68% of individuals with medical conditions, particularly comorbidities related to high rates of depression and anxiety (6). The National Comorbidity Survey Replication in the United States found physical disorders among more than 68% of adults with a mental disorder and mental disorders among 29% of adults with a physical disorder (7). A meta-analysis reported that mental/physical comorbidities ranged from 19.0 to 68.1% in developing countries (8). Other global studies suggest an association between chronic pain conditions and mental disorders, including mood, anxiety, somatoform, substance use, and personality disorders (9–15). Such comorbidities have been largely linked to functional disability and significant loss of quality of life (10, 13).

The Arab world reports similar findings on mental/physical comorbidities (16). According to a study conducted in Aleppo, Syria, depression was higher in people with stroke and heart disease (17). In the context of the Kingdom of Saudi Arabia (KSA), up to 30% of patients with colorectal cancer meet criteria for major depressive disorder (18). Other Saudi studies suggest a strong association between depression and cardiovascular disease (19), high rates of anxiety and depression among children and adolescents with chronic pain conditions (20), with 71% of those with a pain condition related to a disease — such as cancer and osteoarthritis — meeting criteria of depression (21).

Specific sociodemographic risk factors for mental/physical comorbidity include: higher age, female gender, and lower education (22). Those with pain conditions in the KSA, who are financially discontent, are three times more likely to have depression compared to those who are financially content (21). Compared to other age groups, Saudis aged 40–59 with chronic pain have an increased risk of depression (21). Mental disorders and chronic physical conditions are associated with higher levels of disability and role impairment among Saudis (23, 24): yet only a small percentage receive or seek treatment (25). The effects of comorbid mental disorders are reported to lead to higher treatment costs, functional impairment, and prolonged duration of treatment (23, 26). It is important to note that there are several possible reasons for such comorbidities to exist: (1) the mental disorder causes the chronic physical condition (or vice versa), (2) the conditions influence and mutually maintain each other in some way, (3) a third factor (e.g., a sociodemographic characteristic) increases the risk of developing both mental disorders and chronic physical conditions, or (4) the conditions occur independently, by a mechanism that is unrelated to the other (27). These outlined findings emphasize the critical need for evidence based-studies aimed at understanding the burden of comorbidities, in order to develop policy frameworks for interventions to prevent further comorbidity development.

Although informative, basic epidemiological findings on mental/physical comorbidity in the KSA general population are lacking. Overall, previous Saudi studies have focused on such comorbidity patterns between selected chronic physical conditions and mental disorders (22, 28–30), and this among specific populations (31). To the best of our knowledge, there are no published studies that have used rigorous field methods to examine comorbidities of broad chronic physical conditions and mental disorders, and the correlates of such comorbidities among the general population in the KSA.

This study uses data collected by the Saudi National Mental Health Survey (SNMHS), a national epidemiological survey conducted in the KSA, as part of the World Mental Health (WMH) Survey Initiative (32). Under the WMH Consortium (33), all participating countries conduct general population surveys using the World Health Organization (WHO) WMH Composite International Diagnostic Interview 3.0 (CIDI) to retrospectively assess mental disorders, based on the *Diagnostic and Statistical Manual of Mental Disorders* IV (DSM-IV). The present study is one of the first Arab studies under the WMH Consortium to investigate the relationship between mental disorders and chronic conditions. The aims of the study are to examine (i) the prevalence of DSM-IV 12-month mental disorders among Saudis with lifetime chronic physical conditions, (ii) the sociodemographic correlates of chronic physical conditions, (iii) the interaction of 12-month mental disorders with sociodemographic correlates of chronic physical conditions, and (iv) the associations between such comorbidities and disability among Saudis in the KSA. National estimates on such comorbidities are needed to inform mental health stakeholders, and policymakers involved in improving the quality of life of the affected individuals.

2 Materials and methods

2.1 Sample

The sample was obtained from the SNMHS. As described previously, (34, 35) the SNMHS was based on a multi-stage clustered probability sample of Arabic-speaking household citizens aged between 15 and 65 years old, living in urban and rural areas of the KSA. Over 28 months between 2014 and 2016, trained lay interviewers conducted face-to-face interviews, as per the general methods of the WMH survey initiative. The response rate for a total sample of 4,004 participants was 61%. The interviews were conducted in two parts in an effort to reduce respondent burden and control study costs, thereby enhancing the data collection process and enabling a comprehensive assessment of research objectives. Part I included a core diagnostic assessment that was given to all respondents. Part II included questions about risk factors, consequences, other correlates, and assessments of additional disorders. Part II was given to all Part I respondents who had any core disorder, as well as a 25% probability sub-sample of other Part I respondents ($n = 1981$). Prior to the interview, the interviewers obtained written informed consent. This study was performed in line with the principles of the Declaration of Helsinki. Field procedures and consent were approved by the

Institutional Review Board committee at the King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia. The characteristics of the sub-sample with chronic physical conditions are presented in Table 1.

TABLE 1 Prevalence of chronic physical conditions in the total sample, and the characteristics of the sub-sample.

	N	%	SE
Any physical condition	1,538	69.07	1.99
Medical condition	476	19.67	1.41
Pain condition	1,479	65.62	2.02
Any mental disorders ($N = 1{,}538$)			
Yes	545	24.00	1.56
No	993	76.00	1.56
Gender			
Female	967	57.74	2.23
Male	571	42.26	2.23
Age			
15–22	374	25.45	1.96
23–30	357	22.90	1.87
31–49	609	36.49	2.15
50+	198	15.15	1.83
Education			
Low	266	19.26	1.88
Low Average	211	13.56	1.49
High Average	515	31.16	2.08
High	546	36.02	2.17
Income			
Low	648	44.76	2.31
Low Average	152	8.65	1.14
High Average	231	15.54	1.51
High	507	31.05	1.99
Marital status			
Married	901	51.80	2.27
Separated/Divorced/ Widowed	117	7.87	1.28
Never Married	520	40.33	2.25
Urban/Rural			
Urban	1,369	84.99	1.99
Rural	169	15.01	1.99
Region			
Central	536	32.97	2.04
Eastern	217	19.59	1.92
Northern	152	3.90	0.50
Southern	167	11.26	1.27
Western	466	32.28	2.25
Employment			
Employed	473	31.10	2.03
Self-Employed	29	3.09	0.93
Unemployed	120	7.07	1.05
Retired	53	4.60	1.11
Homemaker	477	27.13	2.08
Student	361	24.65	1.96
Other [Ψ]	25	2.36	0.60

Ψ Other includes disabled, maternity leave, sick leave, do not know, refused.
Part II weights were used.

2.2 Measures

2.2.1 Mental disorders

The mental disorder diagnoses were based on the WHO-WMH CIDI 3.0 – a fully structured lay administered interview that generates diagnoses according to the criteria of DSM-IV (36). The computerized version of CIDI 3.0 was translated into Arabic and adapted to suit the local culture, then validated in the Arabic-speaking local population (34, 37, 38). The clinical reappraisal study of the Saudi CIDI showed valid and conservative diagnoses of common mental disorders in the Saudi population (39).

Twelve-month disorders assessed by the instrument criteria were used, and classified as follows: anxiety disorders (panic disorder, generalized anxiety disorder, agoraphobia without panic disorder, social phobia, posttraumatic stress disorder, obsessive-compulsive disorder, separation anxiety disorder), mood disorders (major depressive disorder, bipolar disorder I or II), impulse control disorders (conduct disorder, attention-deficit/hyperactivity disorder, intermittent explosive disorder), substance use disorders (alcohol and drug abuse and dependence) and eating disorders (anorexia, binge eating disorder, bulimia). The DSM-IV organic exclusion rules and diagnostic hierarchy rules were applied to the diagnoses as described elsewhere (24).

2.2.2 Chronic physical conditions

Lifetime chronic conditions were assessed as part of the adapted CIDI 3.0, and were grouped into the following categories in this study: any medical condition (heart disease, high blood pressure, asthma, other chronic lung diseases [like chronic obstructive pulmonary disease, tuberculosis or emphysema], cancer; any pain condition (arthritis, chronic back or neck pain, frequent or severe headaches, other chronic pain); and any physical condition (any condition reported in either the medical or pain category).

2.2.3 Sociodemographic correlates

Sociodemographic correlates included age (15–24 years, 25–34 years, 35–49 years, and 50 and above years), gender, completed years of education (0–6 years, i.e., low; 7–9 years, i.e., low-average; 10–15 years, i.e., high-average; and 16 years or more, i.e., high), and marital status (married, separated or widowed or divorced, and never married). Family income was defined as the household income divided by the number of people in the household. A case was assigned a category on a scale based on the *per capita* income of the respondent's household divided by the median income for the country, where it was categorized as low if it was less than half the median, low-average if half the whole median, high-average if up to twice the median, and high if greater than twice the median. Employment included those who are employed, self-employed, unemployed, retired, a homemaker, a student, and others (such as disabled, maternity leave, sick leave, refused to answer, do not know). Urbanicity (rural, and urban) and region (Central [Riyadh, Al Qaseem, Hail], Eastern [Eastern Province], Northern [Northern Frontier, Al-Jouf, Tabouk], Southern [Aseer, Al-Baha], and Western [Makkah, Al-Madinah]) (35) were extracted from the sample frame (2010 Census) that was provided by the General Authority for Statistics in Saudi Arabia.

2.2.4 Disability

Assessment of disability was similar to previous WMH studies (23, 40). Disability was measured in terms of 'days out of role' in the last 30 days, using the Work Loss Days (WLD) index of the World Health Organization Disability Assessment Schedule (WHODAS-II) (41). The WLD index assesses both days with full disability (i.e., in which the respondent is totally unable to perform daily tasks as usual (42), and days with partial disability (43). Full disability was estimated by asking respondents the number of days in the 30 days before interview (that is, beginning yesterday and going back 30 days) they were totally unable to work or carry out your normal activities because of problems with either their physical health, mental health, or use of alcohol or drugs. Partial disability was defined as the number of days in which respondents (a) had to cut down on what they did, assessed by the following item 'How many days out of the past 30 were you able to work and carry out your normal activities, but had to cut down on what you did or not get as much done as usual because of problems with either your physical health, your mental health, or your use of alcohol or drugs?'; (b) had to cut back on the quality of what they did, assessed by the following item: 'How many days out of the past 30 did you cut back on the quality of your work or how carefully you worked because of problems with either your physical health, your mental health, or your use of alcohol or drugs?'; and (c) experienced extreme effort to perform as usual, assessed by the following item: 'How many days out of the past 30 did it take an extreme effort to perform up to your usual level at work or at your other normal daily activities because of problems with either your physical health, your mental health, or your use of alcohol or drugs?'. Using these four questions, a weighted sum of activity limitation days in the prior month was estimated. The following terms were added together: (1) The number of days totally unable to carry out normal activities in the prior month; (2) One-half the number of days of reduced activities; (3) One-half the number of days of reduced quality or care in work activities; and (4) One-quarter the number of days requiring extreme effort to perform at one's usual level. If this sum exceeded 30, it was recoded to equal 30 so that the sum had a range from 0 to 30. The sum was then divided by 30 and multiplied by 100 so that the resulting WLD index score also ranged from 0 to 100.

2.3 Analysis

Sample weights were used to adjust for differential probabilities of selection in between-household and within-household as well as sample and population distrubutions. In brief, Part I weights were used for core-section disorders, while Part II weights were used for noncore-section disorders. Further detail on weighting procedures can be found elsewhere (35). For chronic physical conditions, respondents who reported any medical condition, and any pain condition were counted once each to calculate the total frequencies for both categories; and counted only once for the total frequency of the third category, i.e., any physical condition. Similarly, for all classes of mental disorders (e.g., any anxiety disorders), respondents who reported comorbid mental disorders from other classes of mental disorders (e.g., any mood disorders) were counted once each to calculate total frequencies. Prevalence of mental disorders with each comorbid chronic condition were obtained using crosstabulations with appropriate weights (35) for each disorder. Differences across chronic physical conditions and mental disorders classes were considered at *p*-value threshold of <0.05, using cross tabulations with the Wald chi-square test. The cross tabulations were done using the PROC SURVEYFREQ procedure in SAS 9.2 (SAS Institute Inc., Cary, NC, USA). Multiple logistic regression models were created to investigate associations between the chronic physical conditions, mental disorders, and sociodemographic correlates, as well as for the interaction between comorbidities and sociodemographic correlates. All logistic regression models were created using the PROC LOGISTIC procedure, and reported using odds ratios with 95% confidence intervals, with Wald chi-square tests with *p*-value threshold of <0.05. The WLD means were also calculated with 95% confidence intervals using the PROC MEANS procedure.

3 Results

The prevalence of any lifetime chronic physical condition among Saudis was 69.1%; and the prevalence of any 12-month comorbid mental disorder among those with chronic physical conditions was 24% (Table 1). The majority among those who reported chronic physical conditions were female, aged 31–49, with high education and low income, married, living in an urban area, in the Central or Western region, or employed.

3.1 Mental disorders among respondents with physical conditions

Major depressive disorder (5.9%), social phobia (5.8%), and adult separation anxiety disorder (5.8%) were the most common comorbid mental disorders among Saudis with any medical condition (Table 2). By comparison, social phobia (5.4%) and major depressive disorder (4.6%) were the most prevalent comorbid mental disorders among respondents with any pain condition. These disorders were also the most common comorbid mental disorders among Saudis with any physical condition (with prevalence estimates of 5.2 and 4.8%, respectively).

With regard to impulse control disorders, high rates of attention deficit disorder and intermittent explosive disorder were found among Saudis belonging to all three categories of chronic physical conditions. Binge eating disorder was particularly high (4.5%) among Saudis with any medical condition. Relative to other disorders, substance use disorders such as alcohol abuse (0.1%) were not as prevalent as anxiety disorders and mood disorders among Saudis with chronic physical conditions. Anxiety disorders and mood disorders were the most common comorbid mental disorders across all categories of chronic physical conditions (Table 3). Eating disorders (39.25%) and impulse control disorders (33.57%) were only prevalent and comorbid among Saudis with any medical condition.

TABLE 2 Twelve-month Prevalence of Mental Disorders among Saudis with Chronic Physical Conditions.

Disorders	Any medical condition		Any pain condition		Any physical condition	
	N	%	*N*	%	*N*	%
Anxiety disorders						
Panic disorder[1]	10	0.8	42	1.7	42	1.6
Generalized anxiety disorder[1]	13	2.1	30	1.2	31	1.3
Social phobia[1]	38	5.8	113	5.4	113	5.2
Agoraphobia with/without panic[1]	21	1.7	67	2.5	68	2.4
Post-traumatic stress disorder[2]	19	2.3	56	2.5	56	2.4
Adult separation anxiety disorder[2]	28	5.8	90	4.5	90	4.3
Obsessive-compulsive disorder[2]	18	2.4	56	2.3	56	2.2
Mood disorders						
Major depressive disorder[1]	41	5.9	138	4.6	140	4.8
Bipolar I and/or II[1]	30	5	77	3.5	77	3.3
Impulse control disorders						
Conduct disorder[2]	5	1.1	7	0.4	7	0.3
Attention deficit hyperactivity disorder[2]	24	3.2	78	3.5	79	3.3
Intermittent explosive disorder[2]	25	5.7	56	2.8	58	3
Substance use disorders						
Alcohol abuse[2]	2	0.1	4	0.1	4	0.1
Alcohol dependence[2]	0	-	5	0.3	5	0.3
Drug abuse[2]	14	2.2	32	1.5	33	1.4
Drug dependence[2]	7	0.9	13	0.6	13	0.6
Eating disorders						
Anorexia[2]	0	-	0	-	0	-
Binge eating disorder[2]	20	4.5	40	2.5	42	2.4
Bulimia[2]	14	1.8	31	1.2	31	1.1
More than one disorder[2]	40	8.15	87	3.91	88	4.05

[1] Part I sample, prevalence calculated using part I weights.

[2] Part II sample, prevalence calculated using part II weights. $N = 4{,}004$.

3.2 Correlates of physical conditions

Females were three times more likely than males to report any pain condition, or any physical condition. Compared to older Saudis (50+), those in other age groups had lower risk of any medical condition. Those who had low-average, high average and high levels of education were less likely to report any medical condition (OR = 0.47, $p = 0.0008$; OR = 0.55, $p = 0.0046$; OR = 0.64, $p = 0.0389$), any pain condition (OR = 0.40, $p < 0.0001$; OR = 0.60, $p = 0.0121$; OR = 0.56, $p = 0.0056$), and any physical condition (OR = 0.37, $p < 0.0001$; OR = 0.50, $p = 0.0010$; OR = 0.55, $p = 0.0064$) compared to those who had low levels of education.

Saudis with low average and high average income had lower risk of any pain condition (OR = 0.69, $p = 0.0624$; OR = 0.70, $p = 0.0279$) and any physical condition (OR = 0.55, $p = 0.0028$; OR = 0.65, $p = 0.0084$) compared to those with high income. Being separated/divorced/widowed vs. married was associated with increased risk of any medical condition (OR = 1.74, $p = 0.0103$). Those living in rural areas compared to urban areas were less likely to report any pain condition (OR = 0.54, $p < 0.0001$), and any physical condition (OR = 0.60, $p = 0.0003$). Northern and Southern region vs. Central region of the KSA were associated with lower rates of any medical condition (OR = 0.40, $p = 0.0087$; OR = 0.54, $p = 0.0073$); Northern and Western region vs. Central region were associated with lower rates of any pain condition (OR = 0.35, $p < 0.0001$; OR = 0.69, $p = 0.0039$); and Northern, Southern and Western region vs. Central region were associated with lower rates of any physical condition (OR = 0.27, $p < 0.0001$; OR = 0.63, $p = 0.0134$; OR = 0.62, $p = 0.0003$).

Saudis, who were self-employed and students vs. employed had lower risk of any medical condition (OR = 0.23, $p = 0.0077$; OR = 0.48, $p = 0.0160$). Those who were retired were almost three times more likely than those who were employed to report any pain condition and any physical condition (OR = 2.89, $p = 0.0025$). Employment reports of other types (disabled, maternity leave, sick leave, do not know, refused, etc.) were associated with lower rates of any medical condition (OR = 0.32, $p = 0.0178$), any pain condition (OR = 0.45, $p = 0.0164$), and any physical condition (OR = 0.39, $p = 0.0052$).

TABLE 3 Prevalence of comorbidities stratified by classes of 12-month mental disorders.

Chronic condition	Anxiety disorders$^{2(N = 367)}$				Mood disorders$^{1(N = 244)}$				Eating disorders$^{2(N = 91)}$				Impulse Control disorders$^{2(N = 158)}$				Substance Use disorders$^{2(N = 53)}$				More than one disorder$^{2(N = 214)}$			
	N	%	Wald χ2	Pr > F	N	%	Wald χ2	Pr > F	N	%	Wald χ2	Pr > F	N	%	Wald χ2	Pr > F	N	%	Wald χ2	Pr > F	N	%	Wald χ2	Pr > F
Any medical condition	101	28.31	6.34	0.01	71	34.43	6.59	0.01	34	39.25	5.87	0.02	49	33.57	4.79	0.03	18	27.66	0.62	0.43	70	38.66	10.86	0.001
Any pain condition	318	84.35	27.95	<0.0001	215	80.16	7.35	0.01	71	76.17	2.09	0.15	126	72.63	1.39	0.24	44	76.05	0.89	0.35	186	80.56	8.98	0.002
Any physical condition	320	84.81	20.54	<0.0001	217	83.76	8.90	0.00	73	76.78	1.15	0.28	129	77.17	2.21	0.14	45	76.45	0.44	0.51	187	83.89	10.35	0.001

[1] Part I sample; prevalence calculated using part I weights.

[2] Part II sample; prevalence calculated using part II weights.

The degree of freedom for all categories = 1.

Saudis without mental disorders had systematically lower risk of any medical condition (OR = 0.47, $p < 0.0001$), any pain condition (OR = 0.40, $p < 0.0001$), and any physical condition (OR = 0.44, $p < 0.0001$) compared to those who had a comorbid 12-month mental disorder (Table 4).

Mental disorders were found to interact with gender, age, income, and employment to exert an effect on the risk of any medical condition (Table 5). There were mental disorders interactions with all sociodemographic characteristics except for marital status for the category of any pain condition. Gender, education, income, urbanicity, region, and employment interacted with mental disorders to predict the risk of any physical condition. For instance, females with mental disorders were found to be at a considerably higher risk of developing physical conditions than males ($p < 0.0001$). Additionally, individuals with mental disorders who had high ($p = 0.0009$) and high-average ($p = 0.0001$) education levels had reduced risks of experiencing physical conditions. Individuals in rural areas were also at a notably lower risk of physical conditions ($p < 0.0001$). Furthermore, relative to those living in the Western region, individuals with mental disorders residing in the Central and Eastern regions ($p = 0.0003$ & 0.0003) were at a significantly higher risk for physical conditions, while those in the Northern region were at a lower risk ($p = 0.0001$) (Supplementary Table S1).

3.3 Mental/physical comorbidity and work loss days indices

We found meaningful associations between comorbidities and days out of role in the last 30 days (Table 6): respondents without mental disorders or chronic physical conditions had 0.27 days out of role (CI: 0.12–0.43, SE: 0.11) — on average — in the last 30 days. Those with 12-month mental disorders but without any physical conditions had 4.44 (CI: 2.73–6.15, SE: 0.86) days out of role. Saudis with chronic physical conditions but without any mental disorder had 1.18 (CI: 0.90–1.47, SE: 0.14) days out of role, and those with comorbidities of mental disorder and chronic physical condition had an average of 2.97 (CI: 2.45–3.49, SE: 0.26) days out of role in the last 30 days.

4 Discussion

This is one of the first Arab studies under the WMH Consortium to examine comorbidities of chronic physical conditions and mental disorders in the general population of a country from the Gulf Cooperation Council (GCC). We found that chronic physical conditions among Saudis were common. In addition, about one in four Saudis with chronic physical conditions reported comorbid mental disorders. Specifically social phobia, adult separation anxiety disorder, and major depressive disorder were common mental disorders across all chronic physical condition categories. Overall, anxiety disorders were commonly comorbid across all chronic physical conditions; a large proportion (84.34%) of Saudis with any pain condition had comorbid anxiety disorders, as well as any physical condition comorbid with anxiety disorders (84.81%). These results were similar to other WMH studies (4, 9, 11, 40, 44), as well as with Arab (16) and Saudi studies with chronic physical condition clinical patients (18, 21).

TABLE 4 Association of Chronic Physical Conditions and Correlates.

	Any Medical Condition			Any Pain Condition			Any Physical Condition		
	OR	(95% CI)	*p*-Value	OR	(95% CI)	*p*-Value	OR	(95% CI)	*p*-Value
Any mental disorders[2]									
Yes	1.00			1.00			1.00		
No	0.47	(0.35–0.62)	<0.0001	0.40	(0.3–0.54)	<0.0001	0.44	(0.33–0.59)	<0.0001
Wald χ^2	28.54			38.65			29.46		
Gender									
Female	1.29	(0.93–1.79)	0.1209	3.10	(2.37–4.04)	<0.0001	3.11	(2.36–4.1)	<0.0001
Male	1.00			1.00			1.00		
Wald χ^2	2.41			69.16			65.27		
Age			0.0013			0.3819			0.8657
15–22	0.42	(0.2–0.87)	0.0186	0.68	(0.36–1.27)	0.2212	0.97	(0.51–1.85)	0.9279
23–30	0.35	(0.21–0.59)	<0.0001	0.72	(0.43–1.19)	0.1970	0.94	(0.56–1.59)	0.8222
31–49	0.63	(0.42–0.94)	0.0240	0.69	(0.45–1.05)	0.0837	0.86	(0.55–1.33)	0.4912
50+	1.00			1.00			1.00		
Wald χ^2	15.70			3.06			0.73		
Education			0.0047			0.0003			<0.0001
Low	1.00			1.00			1.00		
Low Average	0.47	(0.3–0.73)	0.0008	0.40	(0.26–0.61)	<0.0001	0.37	(0.24–0.57)	<0.0001
High Average	0.55	(0.37–0.83)	0.0046	0.60	(0.4–0.89)	0.0121	0.50	(0.33–0.76)	0.0010
High	0.64	(0.42–0.98)	0.0389	0.56	(0.37–0.85)	0.0056	0.55	(0.36–0.85)	0.0064
Wald χ^2	12.96			18.58			21.17		
Income			0.4012			0.0651			0.0076
Low	1.06	(0.77–1.46)	0.7229	0.74	(0.56–0.97)	0.0293	0.76	(0.57–1.01)	0.0163
Low Average	0.83	(0.52–1.35)	0.4605	0.69	(0.47–1.02)	0.0624	0.55	(0.37–0.82)	0.0028
High Average	0.80	(0.55–1.16)	0.2357	0.70	(0.52–0.96)	0.0279	0.65	(0.48–0.9)	0.0084
High	1.00			1.00			1.00		
Wald χ^2	2.94			7.23			11.94		
Marital status			0.0371			0.7423			0.3547
Married	1.00			1.00			1.00		
Separated/Divorced/ Widowed	1.74	(1.14–2.66)	0.0103	0.84	(0.51–1.38)	0.4830	1.27	(0.72–2.24)	0.4176
Never Married	1.11	(0.74–1.68)	0.6131	0.93	(0.66–1.32)	0.6817	0.82	(0.57–1.17)	0.2757
Wald χ^2	6.59			0.60			2.07		
Urban/Rural									
Urban	1.00			1.00			1.00		
Rural	0.80	(0.56–1.14)	0.2236	0.54	(0.41–0.71)	<0.0001	0.60	(0.45–0.79)	0.0003
Wald χ^2	1.48			18.93			12.94		
Region			0.0120			<0.0001			<0.0001
Central	1.00			1.00			1.00		
Eastern	0.84	(0.6–1.19)	0.3312	1.38	(1–1.9)	0.0527	1.19	(0.85–1.67)	0.3048
Northern	0.40	(0.21–0.8)	0.0087	0.35	(0.22–0.54)	<0.0001	0.27	(0.18–0.43)	<0.0001
Southern	0.54	(0.34–0.85)	0.0073	0.73	(0.51–1.04)	0.0784	0.63	(0.44–0.91)	0.0134
Western	0.77	(0.58–1.03)	0.0733	0.69	(0.53–0.89)	0.0039	0.62	(0.47–0.8)	0.0003
Wald χ^2	12.86			41.02			48.57		
Employment			0.0053			0.0030			0.0029
Employed	1.00			1.00			1.00		
Self-Employed	0.23	(0.08–0.68)	0.0077	1.65	(0.92–2.94)	0.0911	1.49	(0.82–2.68)	0.1879
Unemployed	0.66	(0.37–1.17)	0.1560	1.24	(0.78–1.98)	0.3686	1.20	(0.74–1.94)	0.4531
Retired	1.43	(0.78–2.62)	0.2464	2.89	(1.45–5.74)	0.0025	2.75	(1.35–5.57)	0.0051
Homemaker	0.81	(0.53–1.23)	0.3160	1.09	(0.73–1.61)	0.6863	0.91	(0.6–1.37)	0.6531
Student	0.48	(0.27–0.87)	0.0160	1.04	(0.67–1.61)	0.8570	0.85	(0.55–1.33)	0.4847
Other [Ψ]	0.32	(0.12–0.82)	0.0178	0.45	(0.23–0.86)	0.0164	0.39	(0.2–0.75)	0.0052
Wald χ^2	18.41			19.78			19.91		

Ψ Other includes disabled, maternity leave, sick leave, do not know, and refused.

Part II Weights were used.

TABLE 5 Mental disorders interactions of sociodemographic correlates and chronic physical conditions.

Effect	Any medical condition			Any pain condition			Any physical condition		
	DF	Wald Chi-Square	Pr > ChiSq	DF	Wald Chi-Square	Pr > ChiSq	DF	Wald Chi-Square	Pr > ChiSq
Any mental disorders * gender	1	6.4862	0.0109	1	58.1913	<0.0001	1	51.9596	<0.0001
Any mental disorders * age	3	13.8958	0.0031	3	9.5056	0.0233	3	2.3549	0.5021
Any mental disorders * education	3	2.617	0.4545	3	19.7106	0.0002	3	20.4171	0.0001
Any mental disorders * income	3	7.6858	0.053	3	9.8179	0.0202	3	18.1043	0.0004
Any mental disorders * marital status	2	4.3148	0.1156	2	1.1484	0.5632	2	3.5203	0.172
Any mental disorders *urban/rural	1	1.8334	0.1757	1	28.1706	<0.0001	1	18.668	<0.0001
Any mental disorders * region	4	8.0999	0.088	4	39.6121	<0.0001	4	46.4706	<0.0001
Any mental disorders * employment	6	17.2664	0.0084	6	19.2934	0.0037	6	19.2506	0.0038

*Interaction between the two categories.

TABLE 6 Days out of role in the last 30 days for Saudis with 12-month mental disorders and lifetime chronic physical conditions.

Condition	Prevalence				Mean Days Out of Role in the last 30 days		
	N	%	SE	95% CI	Mean	SE	95% CI
Mental disorder only	94	3.62	0.61	(2.41–4.83)	4.44	0.86	(2.73–6.15)
Physical condition only	993	52.49	2	(48.56–56.42)	1.18	0.14	(0.90–1.47)
Both mental disorder and physical condition	545	16.58	1.09	(14.42–18.73)	2.97	0.26	(2.45–3.49)
No mental disorder or physical condition	349	27.31	1.97	(23.44–31.18)	0.27	0.11	(0.12–0.43)

Part II weights were used; *n* = 1981.

Also in line with global (4, 11, 13, 45, 46), Arab (16), and Saudi studies (21, 29, 47), Saudis without comorbid 12-month mental disorders had lower rates of chronic physical conditions. Also, our findings related to the burden of comorbidities, and disability in terms of days out of role were supported by the Global Burden of Disease Study in the KSA (48). These results highlight the role of such burdens on impairment and loss of productivity, thereby pointing to the importance of addressing the large impact of mental/physical comorbidities on quality of life in local healthcare reforms (23). Additionally, that substance use disorders were generally less associated with chronic physical conditions than has been previously reported (15) can be largely attributed to the ban on alcohol and drug consumption and the limited availability of substances in the country (49).

Older age, low education, being separated/divorced/widowed, living in the Central region of the KSA, and being employed were associated with increased risk of any medical condition. Mental disorders interacted with the sociodemographic correlates (excluding marital status) to predict the risk of chronic physical conditions categories among Saudis. Future research is warranted, given that this study did not examine the temporal relationships between the conditions, and causal mechanisms of such comorbidities. However, as previously mentioned, a number of relationship scenarios are possible between the conditions. It is possible that the mental disorder or chronic physical condition cause or influence one another in certain ways, or that certain sociodemographic factors increase vulnerability to either condition, or even that the conditions do not influence each other, but simply coincide (27).

Within the context of the KSA, the New Models of Care – outlined by the Ministry of Health for the Vision 2030, Health Sector Transformation Strategy (50) – specify chronic conditions as a prioritized system of care, and recognize that the mental health services in the country are underdeveloped, and need to be taken into account as the healthcare development progresses. Currently, the Saudi government ensures that 'Comprehensive Health Guidance Initiative' under the primary mental health program of the Ministry of Health, provides integrated mental health treatment – to some extent – in physical health treatment. The aims of this program include early detection of depression and anxiety among primary health centres' outpatients, and provision of primary mental health services for prevention of chronic diseases (51). Previous Saudi reports also indicate that pharmacotherapy – specifically polypharmacy, i.e., use of multiple medication – is common among outpatients with medical conditions (52) and mental disorders (53). However it is unclear how effectively and explicitly comorbidities are targeted, or addressed in the healthcare sector, or across other sectors in the KSA generally. Saudi studies in the past has advocated for multidisciplinary approaches such as the biopsychosocial model to be considered by healthcare professionals, to address mental disorders among individuals with chronic physical conditions, especially in hospitals (21, 47). Furthermore, although the National Center for Mental Health Promotion provides accessible psychological education services to the public (54), tailored healthcare efforts, support services, and awareness campaigns explicitly addressing comorbidities of mental disorders and chronic physical conditions among the general population are needed.

The findings of this study must be interpreted in light of the following limitations. First, the assessment of comorbidities in this study may be different from that of a clinical population survey. Symptoms of mental disorders such as fatigue in depressive disorders may also be common for chronic illnesses; comorbidities in this study were assessed without applying any exclusionary criteria for entangled symptoms of physical and mental disorders (40). Also, psychotic disorders, such as schizophrenia, that did not fall within the scope of the SNMHS may also be commonly linked with medical comorbidities (55). Second, due to the stigma surrounding mental disorders and self-reporting of symptoms and chronic conditions, the prevalence of comorbidities in this study may be an underestimation. However, there is evidence to support that self-reports generally show good concordance with medical reports for chronic diseases (46, 56). Third, given the cross-sectional nature of this study, any indicated associations between comorbidities and correlates do not imply causation. Prospective research studies could investigate ages of onset of mental disorders and chronic physical conditions to understand the relationship between these disorders as well as determine the course of comorbid chronic conditions (9).

5 Conclusion

Using nationally representative data from the SNMHS, this study investigated the dual burden of mental disorders and chronic physical conditions and their association with sociodemographic correlates and disability. Our findings demonstrate that such comorbidities were common among the Saudi population, particularly mood and anxiety disorders. Mental/physical disorders were linked to a number of sociodemographic correlates as well as significant disability. Overall, the findings of this study provide a valuable point of comparison alongside other surveys from high-income countries under the WMH Consortium — the vast majority of which were conducted among Western populations. Our study also contributes to a growing body of Saudi literature, and provides national estimates related to comorbidities that were unavailable before. These estimates will inform social, mental and health policies across the country and the GCC, in terms of identifying vulnerable groups at risk for comorbidities, and developing prevention and treatment services tailored to their specific health needs.

Data availability statement

The datasets presented in this article are not readily available because of restrictions in the informed consent language used to recruit respondents and WMH consortium agreements. Requests to access the datasets should be directed to the corresponding author at yasmint@kfshrc.edu.sa.

Ethics statement

The studies involving humans were approved by Institutional Review Board committee at the King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

YA and LB: conceptualization and supervision. YA, LB, AA-S, and AA-H: project administration, investigation, funding acquisition, and resources. YA, LB, MN: methodology. MN: Formal analysis. LB, SH, and AA: writing - original draft preparation. YA, RB, LB, SH, and AA: writing - review and editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

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The effects of psychiatric disorders on the risk of chronic heart failure: a univariable and multivariable Mendelian randomization study

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Background: Substantial evidence suggests an association between psychiatric disorders and chronic heart failure. However, further investigation is needed to confirm the causal relationship between these psychiatric disorders and chronic heart failure. To address this, we evaluated the potential effects of five psychiatric disorders on chronic heart failure using two-sample Mendelian Randomization (MR).

Methods: We selected single nucleotide polymorphisms (SNPs) associated with chronic heart failure and five psychiatric disorders (Attention-Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Major Depression, Bipolar Disorder and Schizophrenia (SCZ)). Univariable (UVMR) and multivariable two-sample Mendelian Randomization (MVMR) were employed to assess causality between these conditions. Ever smoked and alcohol consumption were controlled for mediating effects in the multivariable MR. The inverse variance weighting (IVW) and Wald ratio estimator methods served as the primary analytical methods for estimating potential causal effects. MR-Egger and weighted median analyses were also conducted to validate the results. Sensitivity analyses included the funnel plot, leave-one-out, and MR-Egger intercept tests. Additionally, potential mediators were investigated through risk factor analyses.

Results: Genetically predicted heart failure was significantly associated with ADHD (odds ratio (OR), 1.12; 95% CI, 1.04–1.20; $p = 0.001$), ASD (OR, 1.29; 95% CI, 1.07–1.56; $p = 0.008$), bipolar disorder (OR, 0.89; 95% CI, 0.83–0.96; $p = 0.001$), major depression (OR, 1.15; 95% CI, 1.03–1.29; $p = 0.015$), SCZ (OR, 1.04; 95% CI, 1.00–1.07; $p = 0.024$). Several risk factors for heart failure are implicated in the above cause-and-effect relationship, including ever smoked and alcohol consumption.

Conclusion: Our study demonstrated ADHD, ASD, SCZ and major depression may have a causal relationship with an increased risk of heart failure. In contrast, bipolar disorder was associated with a reduced risk of heart failure, which could potentially be mediated by ever smoked and alcohol consumption. Therefore, prevention strategies for heart failure should also incorporate mental health considerations, and vice versa.

KEYWORDS

chronic heart failure, psychological disorders, univariable Mendelian, multivariable Mendelian randomization, causal relationship

Introduction

Chronic heart failure (HF) is a rapidly growing public health problem with an estimated prevalence of more than 37.7 million people worldwide (1). Psychiatric disorders, such as depression, also constitute a substantial burden on public health (2). Notably, there is a high prevalence of psychological disorders, including depression, in patients with cardiovascular diseases, particularly heart failure (3). Previous studies (4–6) demonstrated significant associations between psychiatric conditions like schizophrenia, bipolar mood disorder, and depression, and increased 30-day and overall readmission rates among African-American heart failure patients. Furthermore, heart failure patients with severe psychiatric disorders have been found to experience adverse outcomes and higher postprocedural mortality rates. These findings suggest a link between heart failure and psychological issues; however, determining the causal relationship between them is crucial for guiding treatment strategies in clinical settings.

Mendelian randomization (MR) is a method that utilizes genetic variants, specifically single nucleotide polymorphisms (SNPs), as instrumental variables (IVs) to establish causal relationships between diseases (outcomes) and risk factors (exposures) (7). The research design of MR adheres to the Mendelian inheritance principle, wherein parents' alleles are randomly assigned to their offspring, and the natural causal effects of genetic variants on phenotypes are observed. SNPs are independent of potential confounding factors and strongly related to exposure factors (8). Mendelian randomization relies on three assumptions: (1) instrumental variables and exposure factors are strongly correlated; (2) instrumental variables and confounders are not correlated; and (3) instrumental variables are not directly correlated with the outcome, and their effect on the outcome can only be manifested through exposure (9). Two-sample Mendelian randomization (2SMR) is a technique for estimating the causal effect of exposure on outcomes using genome-wide association study (GWAS) summary data (10). To date, two-sample Mendelian randomization has been widely employed in the field of cardiovascular diseases, including heart failure (11–13). However, the causal relationship between psychiatric disorders and heart failure remains largely unexplored. Therefore, we conducted a two-sample MR analysis using summary data from the GWAS to assess the causal effect of five psychiatric disorders (i.e., ADHD, ASD, SCZ, bipolar disorder and major depression) on the risk of heart failure.

Consequently, we carried out a two-sample MR analysis using summary data from GWAS to evaluate the possible causal impact of five psychiatric disorders—namely, attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), schizophrenia (SCZ), bipolar disorder and major depression—on the risk of heart failure.

Method

Study design

An overview of the two-sample Mendelian randomization (MR) analysis conducted in this study is provided in Figure 1. We employed both univariable and multivariable Mendelian randomization (UVMR and MVMR) using single nucleotide polymorphisms (SNPs) as instrumental variables for the psychiatric disorders to assess the causality between five psychiatric disorders (ADHD, ASD, SCZ, bipolar disorder and major depression) and heart failure. Additionally, we analyzed several potential mediating factors, such as ever smoked and alcohol consumption, to explore the genetic mechanisms of psychiatric disorders and heart failure independent of potential confounders. The study was conducted in accordance with the Enhancing the Quality and Transparency of Health Research (EQUATOR) guidelines (7). All MR analyses satisfied the three basic assumptions: (1) instrumental variables and exposure factors are strongly correlated; (2) instrumental variables and confounders are not correlated; and (3) instrumental variables are not directly correlated with the outcome, and their effect on the outcome can only be reflected through exposure.

Data sources

A detailed overview of all data sources is provided in Table 1. We obtained publicly available summary statistics from genome-wide association studies (GWAS) to conduct the MR analyses. The summary statistics for the outcome of heart failure included 47,309 cases and 930,014 controls, from 26 cohorts (with a total of 29 distinct datasets). Cases consisted of participants with a clinical diagnosis of heart failure of any etiology, without inclusion criteria based on left ventricular (LV) ejection fraction; controls were participants without heart failure (14).

For all psychiatric disorders, GWAS datasets obtained in our study included: ADHD with 20,183 cases and 35,191 controls from 12 cohorts from Psychiatric Genomics Consortium (PGC) (15); ASD with 18,382 cases and 27,969 controls from the iPSYCH-PGC (16); bipolar disorder with 20,352 cases and 31,358 controls from Bipolar Disorder Working Group of the Psychiatric Genomics Consortium (17); major depression with 170,756 cases and 329,443 controls from the PGC (18); SCZ with 33,640 cases and 43,456 controls subjects from the Schizophrenia Working Group of the Psychiatric Genomics Consortium (19); ever smoked with 99,996 subjects from Within family GWAS consortium (20); alcohol consumption with 83,626 subjects from Within family GWAS consortium (20). GWAS datasets of two potential confounders obtained were from within family GWAS consortium. All participants of the original studies provided written informed consent.

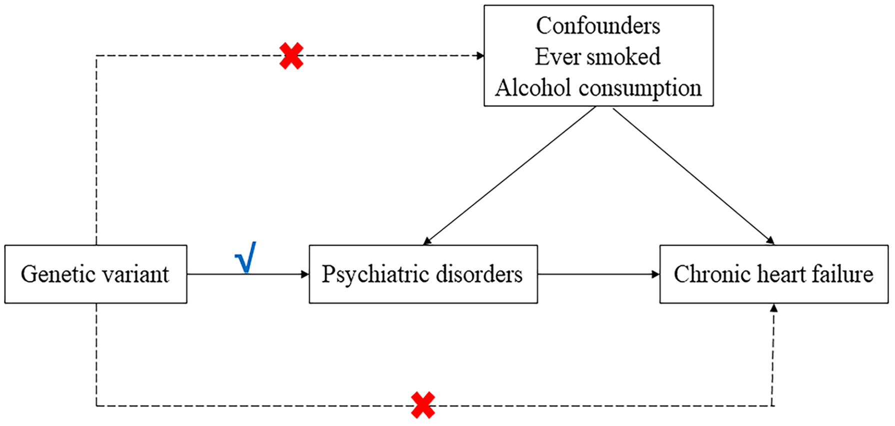

FIGURE 1
Directed a cyclic graph model of the causal effect between psychiatric disorders and heart failure.

TABLE 1 Overview of data sources of this Mendelian randomization study on psychiatric disorders and heart failure.

Consortium	Participants	Phenotype	Population	Type of variables	PMID and/or web link
PCG	20,183 cases and 35,191 controls	ADHD	European	Exposure	30478444
iPSYCH-PGC	18,382 cases and 27,969 controls	ASD	European	Exposure	30804558
PGC	170,756 cases and 329,443 controls	Major depression	European	Exposure	30718901
Bipolar Disorder Working Group of the PGC	20,352 cases and 31,358 controls	Bipolar disorder	European	Exposure	31043756
Within family GWAS consortium	47,517 individuals	Depressive symptoms	European	Exposure	35534559
Schizophrenia Working Group of the PGC	33,640 cases and 43,456 controls	Schizophrenia(SCZ)	European	Exposure	25056061
Within family GWAS consortium	99,996 individuals	Ever smoked	European	Confounder	35534559
Within family GWAS consortium	83,626 individuals	Alcohol consumption	European	Confounder	35534559
GIANT	681,275 individuals	body mass index	European	Confounder	30124842
NA	47,309 cases and 930,014 controls	Heart Failure	European	Outcome	31919418

Exposed genetic instrumental variables (IVs) were selected at a genome-wide significance level ($p<5\times10^{\wedge-8}$). Then we used the PLINK algorithm to exclude SNPs from the linkage disequilibrium within a region of 5,000 Kb, with linkage disequilibrium not exceeding the limited $r^{\wedge2}$ value of 0.001(except for SCZ, we set the threshold at $r^{\wedge2}$ value of 0.01) and not being palindromic with intermediate allele frequencies. According to previous studies, the exposure-related F statistic of the instrument is significantly higher than 10 (21) (Supplementary material). Additionally, two-sample MR assumed independence between exposure data and outcome data. Therefore, data on psychiatric disorders with significant overlapping cohorts with heart failure were excluded.

Statistical analysis

The MR study was conducted in R version 4.1.2 (R Development Core Team, Vienna, Austria) using the "Two-Sample MR" R package version 0.5.6. Two-sample MR and multivariate MR analyses were conducted by the functions mr and mv_multiple, respectively (22). The multiplicative inverse variance-weighted (IVW) method was used in the univariable MR analysis (23). IVW was as the primary analysis to estimate the associations between psychiatric disorders and chronic heart failure. Heterogeneity test, pleiotropy test (MR-Egger intercept test), and leave-one-out analysis were used to estimate sensitivity analysis. For multivariable analysis, we included ever-smoked status and alcohol consumption in the analysis for adjustment. The IVW method was also used for the causal estimates in the multivariable analysis.

Results

Two-sample Mendelian randomization of psychiatric disorders (exposure) on heart failure (outcome)

Univariable MR analysis suggested that there were 9, 1, 11, 41, and 90 IVs for ADHD, ASD, bipolar disorder, major depression and SCZ, respectively. Genetically determined ADHD, ASD, major depression, bipolar disorder and SCZ exhibited a possible causal effect on heart failure (ADHD: OR = 1.12, 95% CI = 1.04–1.20, p = 0.001; ASD: OR = 1.29, 95% CI = 1.07–1.56, p = 0.008; major depression: OR = 1.15, 95% CI = 1.03–1.29, p = 0.015; SCZ: OR = 1.04, 95% CI = 1.00–1.07, p = 0.024; bipolar disorder: OR = 0.89, 95% CI = 0.83–0.96, p = 0.001). The causal estimated effect of psychiatric disorders was broadly consistent with heart failure. The effect estimator for the five psychiatric disorders was robust across IVW; however, it was not consistent across weighted median and MR Egger (Figure 2).

Multivariable Mendelian randomization psychiatric disorders (exposure) on heart failure (outcome)

In multivariable MR analysis adjusting ever-smoked and alcohol consumption, there are strong evidence that ADHD, ASD, bipolar disorder, major depression and SCZ may have possible direct causal effect on heart failure risk (controlling for ever smoked: IVW: OR = 1.12, 95%CI = 1.06–1.18, p = 1.96E-05; controlling for alcohol consumption: IVW: OR = 1.12, 95%CI = 1.08–1.17, p = 3.48E-08; controlling for ever smoked: IVW: OR = 1.26, 95%CI = 1.06–1.47, p = 8.37E-03; controlling for alcohol consumption: IVW: OR = 1.32, 95%CI = 1.08–1.61, p = 0.007; controlling for ever smoked: IVW: OR = 0.91, 95%CI = 0.85–0.97, p = 0.004; controlling for alcohol consumption: IVW: OR = 0.89, 95%CI = 0.83–0.96, p = 0.002; controlling for ever smoked: IVW: OR = 1.15, 95%CI = 1.02–1.30, p = 0.022; controlling for alcohol consumption: IVW: OR = 1.15, 95%CI = 1.03–1.29, p = 0.013; controlling for ever smoked: IVW: OR = 1.03, 95%CI = 1.00–1.06, p = 0.075; controlling for alcohol consumption: IVW: OR = 1.04, 95%CI = 1.01–1.07, p = 0.012) (Figure 3).

Discussion

This is the first MR study to reveal the potential possible causal relationship among the ADHD, ASD, SCZ, bipolar disorder and major depression and heart failure based on large GWAS summary-level data. We discovered genetic evidence that ADHD, ASD, SCZ and major depression were associated with an increased risk of heart failure. Impressively, these adverse possible causal effects remained robust in both univariate and multivariate MR analyses. Other Mendelian randomization study (24) have shown that ASD is associated with a higher risk of heart failure, which is consistent with the findings of our study (though the study did not report on the other psychiatric disorders). Interestingly, our study revealed that bipolar disorder was associated with a decreased risk of heart failure.

The primary objective of multivariate MR model was to assess the effect of multiple relevant exposures on outcomes. Under a range of underlying scenarios, a secondary exposure acts variously as a confounder, a mediator, a pleiotropic pathway and a collider (25). The most significant advantage of MVMR analysis is the robust estimation of the direct effect of each exposure on the outcome in all the scenarios mentioned above. Notably, increased genetic liability to ADHD, ASD, SCZ and major depression was associated with heart failure risk after adjusting for the effects of ADHD, ASD, SCZ and major depression on ever smoked and alcohol consumption, both separately and in a combined model considering potential confounders. However, a decreased genetic liability to bipolar disorder was associated with a reduced risk of heart failure after adjusting for the effects of bipolar disorder on ever smoked and alcohol consumption separately. Although the relationship between bipolar disorder and heart failure presents contrasting results to those reported (26–29), it does not necessarily indicate an issue with our findings. In cases where Mendelian randomization studies themselves have a large number of gene–environment interactions, the influence of genes on disease may be influenced by environmental factors that vary over time or between populations (30). This phenomenon warrants further in-depth exploration.

Furthermore, we conducted a study to systematically assess the causal impact of attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), schizophrenia (SCZ), bipolar disorder and major depressive disorder and heart failure using two sample Mendelian randomization and multivariable Mendelian randomization (MVMR) analyses, including sensitivity analysis.

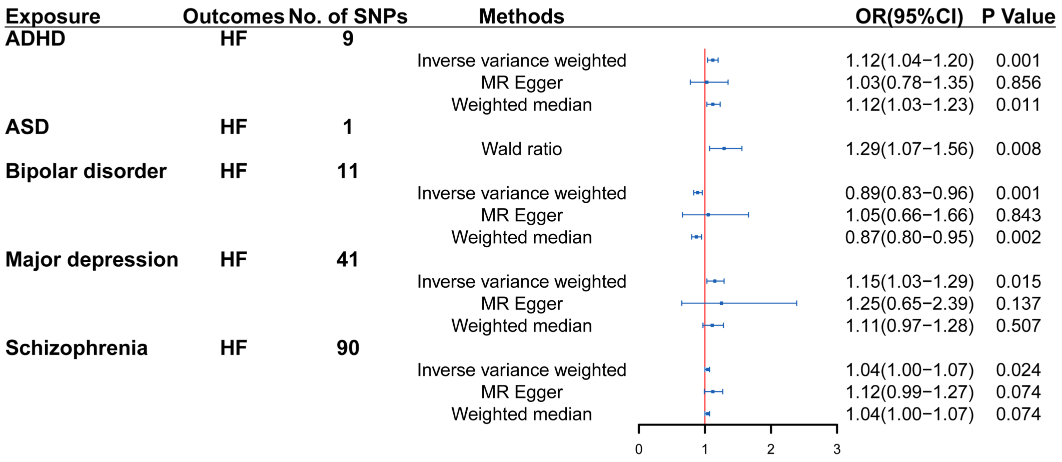

FIGURE 2
Mendelian randomization (MR) association between genetically predicted psychiatric disorders and heart failure. Odds ratios (ORs) are scaled to the risk of heart failure for genetically predicted psychiatric disorders. HF, heart failure; CI, confidence interval.

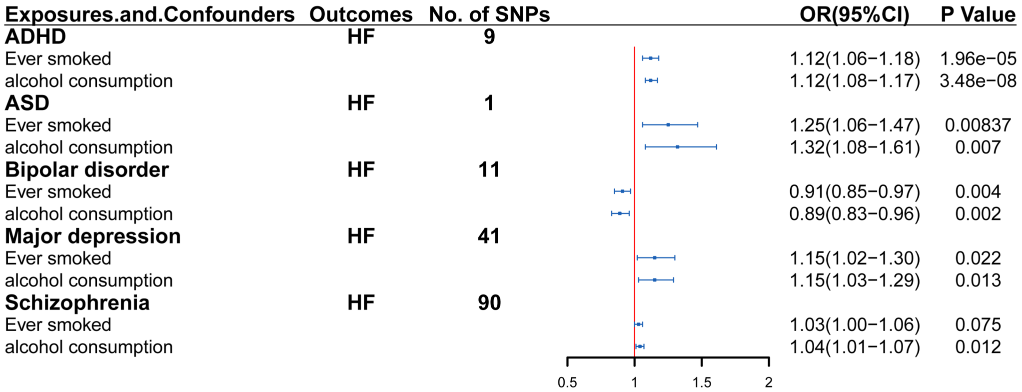

FIGURE 3
Multivariable Mendelian randomization analysis of the effect of psychiatric disorders on heart failure. OR, Odds ratio; CI, confidence interval.

Additionally, we evaluated the effect of confounding factors such as ever smoked and alcohol consumption on the impact of psychological disorders on heart failure. A Mendelian randomization study (31) on the impact of smoking on heart failure revealed a genetic liability to long-term smoking and a higher lifetime smoking burden associated with a higher risk of HF. Other studies (32, 33) have shown that alcohol consumption increases the risk of cardiovascular disease. Biddinger et al. (34) assessed the association of habitual alcohol intake with cardiovascular disease risk. Using multivariate Mendelian randomization analysis of ever smoked, alcohol consumption, psychological disorders (exposure), and heart failure (outcome), we found a strong correlation between psychological disorders and heart failure, even when correcting for confounding factors such as ever smoked and alcohol consumption. These results further suggest that psychological disorders increase the risk of heart failure (except for bipolar disorder). Our results were largely robust to several sensitivity analyses, and by consensus, the Mendelian randomization results on psychological disorders and heart failure are plausible, with psychological disorders increasing the risk of heart failure.

Heart failure is common in adults and accounts for a substantial morbidity and mortality all in the world (35). Furthermore, the pathophysiological process of heart failure can be complicated. Recent studies (36) have shown that activation of the inflammatory response, oxidative stress (37), mitochondrial dysfunction (38), cardiometabolic functional abnormalities (39), myocardial fibrosis (40), endothelial disfunction (41) contribute to cardiac remodeling, leading to an exacerbation of heart failure. We have found that psychological disorders such as depression and anxiety can affect heart patients (42). The underlying mechanisms of psychological disorders in the development of heart failure are not fully understood. Psychological disorders can cause hypercortisolism as well as decreased response to pro-adrenocorticotropic hormone releasing factor (43), activation of platelet function (44), acute stress (45), cardiac arrhythmias (46), endothelial dysfunction (47, 48), activation of mechanisms leading to atherosclerosis, increased inflammatory response (49, 50), etc. There are several possible ways to explain the casual role of psychological disorders in the etiology of heart failure. Psychological disorders appear to promote the secretion of several proinflammatory cytokines, such as CRP and TNF-α (49), affects the level of hormones and vascular endothelium and heart rate. The Mendelian randomization study of psychological disorders and heart failure also revealed that psychological disorders increase the risk of heart failure and may provide a clinical basis for it. All of these psychiatric disorders caused by pathophysiological factors are more or less involved in the progression of heart failure. While the impact of comorbid psychological disorders on heart failure (HF) morbidity and mortality is well recognized, addressing these issues as a routine part of clinical practice holds the potential to enhance quality of life, reduce hospitalizations, improve the cost-effectiveness of care, and positively influence cardiovascular outcomes in patients with HF (42).

The present MR study elucidates the association between psychological disorders and heart failure. This MR study elucidates several merits of the association between genetic liability for psychological disorders and heart failure. The main strengths include the main advantages include the MR design, which mitigates confounding factor relationships, and another advantage is the restriction of the population to European ancestry minimizes bias due to racial heterogeneity. Nevertheless, there are some shortcomings that need to be noted. First, Most of the exposures and outcomes used in our study are binary, and therefore, the Wald-type estimators may bias the causal OR (51). Second, patients with psychiatric disorders may be taking psychotropic drugs, which may have an effect on heart failure, which our study did not analyze. This could also be a direction for future research to support the influence of psychiatric disorders on heart failure. Third, In addition to ever smoked and alcohol consumption as confounders, there may be other confounders that require further exploration in the future. Due to the large sample size of the MR analysis, we believe that the estimated effect will be close to the real situation. However, the homogeneity of the population may limit the generalizability of the results to other populations. Other limitation of this paper, our results demonstrate that the relationship between bipolar disorder and heart failure exhibits the opposite results to those reported, a phenomenon that currently deserves further exploration. It may be that the influence of genes on disease may be influenced by environmental factors that vary from time to time or between populations.

In conclusion, our findings contribute to the growing evidence surrounding the adverse effects of psychological disorders (ADHD, autism spectrum disorder (ASD), schizophrenia (SCZ) and major depressive disorder) on heart failure risk. This highlights the importance of improved diagnosis and management of psychiatric disorders. We believe that in the future, large RCT for psychiatric disorders and heart failure can be conducted, and the population can be expanded to other continents; alternatively, differential SNPs can be concretized into intermediate phenotypes, which can increase the target of clinical intervention.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://gwas.mrcieu.ac.uk/.

Ethics statement

Ethical approval was not required for the studies involving humans because we obtained the database from GWSA for analysis. The studies were conducted in accordance with the local legislation and institutional requirements. We don't have an ethics committee waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because We obtained the database from GWSA for analysis.

Author contributions

YC: Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. WP: Investigation, Methodology, Validation, Writing – review & editing. MP: Investigation, Methodology, Validation, Writing – review & editing. BZ: Investigation, Methodology, Validation, Writing – review & editing. HL: Investigation, Methodology, Validation, Writing – review & editing. DH: Conceptualization, Investigation, Methodology, Software, Writing – review & editing. YL: Conceptualization, Investigation, Methodology, Software, Writing – review & editing. SWa: Conceptualization, Investigation, Methodology, Software, Writing – review & editing. SWu: Conceptualization, Data curation, Investigation, Validation, Writing – review & editing. JH: Conceptualization, Data curation, Investigation, Validation, Writing – review & editing. YY: Conceptualization, Data curation, Investigation, Methodology, Validation, Writing – review & editing. DP: Project administration, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1306150/full#supplementary-material

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Relationship between addictions and obesity, physical activity and vascular aging in young adults (EVA-Adic study): a research protocol of a cross-sectional study

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Background: Behavioral and substance addictions are prevalent health problems that, alongside obesity, are linked to reduced physical activity and increased sedentary time. Similarly, arterial stiffness and vascular aging are processes that begin gradually at an early age and are closely associated with morbidity and mortality from cardiovascular diseases. The main objective of this study is to analyze how addictions are related to obesity and body fat distribution, physical activity, sedentary time, arterial stiffness and vascular aging, as well as sleep quality, cognitive function and gender differences in young adults aged between 18 and 34 years.

Methods: This cross-sectional descriptive observational study will analyze data from 500 subjects (250 men and 250 women) aged 18–34 without cardiovascular disease, selected by simple random sampling with replacement from the urban population of the city center of Salamanca (34,044 people aged 18–34, with 18,450 women and 15,594 men). Behavioral and substance addictions, as well as sleep quality and cognitive impairment will be assessed using questionnaires. The Pittisburg Sleep Quality Index (PSQI) will be used to measure sleep quality and the Ford questionnaire will be used to measure insomnia in response to stress. For obesity, weight, height, waist and hip circumference, body composition will be measured with the *Inbody 230*® impedance meter. For physical activity and sedentary time, we will use the *Actigraph*® accelerometer alongside the international physical activity questionnaire (IPAQ) and the Marshall questionnaire. The *Sphygmocor System*® will be used for pulse wave analysis and carotid-femoral pulse wave velocity (cfPWV), while the *Vasera VS-2000®* will measure cardio ankle vascular index (CAVI) and brachial-ankle pulse wave velocity (baPWV). Vascular aging will be calculated with the 10th and 90th percentiles of cfPWV or baPWV. Demographic, analytical variables will be collected, as will data to assess vascular, cardiac, renal, and brain injury.

Discussion: Addictions are on the rise in today's society, affecting the mental health and well-being of those who suffer from them, generating important social problems such as job loss, family dysfunction, debt and social isolation. Together with obesity, they are prevalent health problems in young adults and are associated with lower physical activity and higher sedentary time. Meanwhile, arterial stiffness and vascular aging are processes that begin gradually at an early age and determine morbidity and mortality caused by cardiovascular diseases. The results of this project will allow us to understand the situation regarding behavioral and substance addictions in young adults. Better understanding of these addictions will in turn facilitate the development of more effective prevention strategies and intervention programs, which can then reduce the negative impact at both the individual and societal levels.

Clinical trial registration: [ClinicalTrials.gov], identifier [NCT05819840].

KEYWORDS

substance-related disorders, gambling, internet use, technology addiction, obesity, healthy lifestyle, physical activity, vascular stiffness

1 Introduction

Behavioral addictions cause loss of control and inability to stop or control addictive behavior, and despite their negative impacts on mental health, they are increasingly prevalent. For these reasons, the National Strategy on Addictions 2017–2024 has incorporated non-substance or behavioral addictions as a new field, with special emphasis on gambling (in-person or online) and addictions through new technologies (1). Thus, gambling with money and the use of Internet, smartphones and video games are common activities among young adults, due partly to the immediacy of reward, ease of access and anonymity they offer (1, 2). These disorders usually begin in adolescence, affecting behavior patterns and causing significant deterioration in personal aspects (1, 3). In Spain, behavioral addictions have increased during the last decade. It is estimated that 58% of the population aged between 15 and 64 years has participated in gambling for money in the last year, with in-person gambling more frequent than online gambling, while 97% of the population have used the internet for recreational purposes during the last month (1). Compulsive internet use has also increased (from 2.9% in 2017 to 3.5% in 2022) and 50% of young people play video games at least weekly (1). These behaviors vary by sex: gambling with money is more frequent among men, while compulsive Internet use is higher in women (1). These behaviors vary by sex: gambling with money is more frequent among men, while compulsive Internet use is higher in women (4, 5). Due to lockdown and social restrictions, these types of behaviors increased during the confinement as a coping strategy for stress or anxiety (6, 7).

Legal substances continue to be the most used substances. According to the latest data published in the EDADES survey, in 1995–2022, 93% of the Spanish population between 15 and 64 years of age reported drinking alcohol and 70% said they had smoked tobacco at some point in their lives, with consumption starting around the age of 16 and being higher in men (8, 9). In addition, drinking alcohol can act as a gateway to other substances (1). In Spain, 33.1% of the population aged between 15 and 64 smoke daily (10). In addition, the use of other modalities such as vaping has increased, especially among 15- to 24-year olds (2). The use of psychoactive substances is higher in men, except for hypnosedatives, which is higher in women (8, 11). In Spain, the use of illegal substances (cannabis, the most widespread, cocaine and ecstasy) has increased in recent years, with a prevalence of 40% for cannabis and 5.1% for ecstasy, at 18 years of age (8, 11, 12). Polydrug use compounds the risks, increasing mental illnesses (10). A recent study found that gender, age, and dual pathology had an impact on substance use and mental health during the pandemic by COVID-19. Men had greater alcohol and cocaine use, while women experienced more depressive and anxiety symptoms. In addition, younger adults were using cocaine and cannabis more frequently, and had more socio-familial and legal problems. Finally, dual pathology was related to the use of benzodiazepines, work problems (unemployment) and anxiety-depressive symptoms. The differences found (in age, gender and dual pathology) should be taken into account when planning health measures in this population (13).

Both general and abdominal obesity are related to an increase in deaths from all causes, being one of the main cardiovascular risk factors (14, 15). Obesity has been on the increase ever since records began (16). According to the WHO, it has almost tripled since 1975; in 2016, more than 1.9 billion adults worldwide aged over 18 were overweight and more than 650 million adults were obese (16). This increase also affects children and adolescents, so between the ages of 5 and 19 it has increased drastically from only 4% in 1975 to more than 18% in 2016 (16). In Spain, this prevalence is 21.6% (22.8% in men and 20.5% in women), with the prevalence of abdominal obesity being 33.4% (23.3% in men and 43.4% in women) (17). This has raised mortality by more than 50%, making it the fourth most preventable factor reducing quality of life (18). This increase is related from early ages to less physical activity, and more sedentary time in front of screens (19, 20).

Physical activity improves quality of life, which benefits the health system and society (21, 22). Thus, most international (23, 24), recommending at least 150 min/week of moderate-high intensity physical activity to obtain benefits. However, physical activity has decreased and sedentary lifestyle and daily time in front of screens have increased (24, 25), raising cardiovascular risk and general mortality (26, 27). Physical activity at younger ages can have positive health effects in adulthood (28, 29). Despite these health benefits, young adults and adolescents sit for many hours a day and many are physically inactive (30). Furthermore, the use of smartphones and other technologies is more prevalent in these age groups (31, 32), assuming an increase sedentary lifestyle (33).

Increased arterial stiffness occurs with a reduction in the elasticity of the arteries, and is a good risk predictor for cardiovascular diseases (CVD) just as important that traditional cardiovascular risk factors (34). Thus, arterial stiffness measured non-invasively has been positively associated with cardiovascular events (35, 36). It is linked to the appearance of vascular aging (37, 38), reflecting the dissociation between the chronological and biological age of the large arteries, with such abnormalities preceding the appearance of cardiovascular events (37, 39). In recent decades, epidemiological studies have been carried out to clarify the determining factors of vascular aging (40), and its study has aroused great interest (37, 38). Vascular aging is a gradual process that begins at an early age and reflect biological aging (37, 41, 42). The advantages of physical activity are known (38). However, the influence of addictions during youth on vascular aging has been little studied. The study of vascular aging in this life stage has aroused great interest in recent decades because it shows a better relationship with morbidity and mortality from cardiovascular diseases than biological aging (37, 38).

These changes in habits also affect other aspects, such as sleep, the duration of which is related with cardiovascular problems (43). Currently, insomnia or unsatisfactory sleep has a prevalence of approximately 6–10% in industrialized countries, with women more affected than men (44). The first meta-analysis to report on the prevalence of mental problems in Spain during the COVID-19 crisis showed that the prevalence of insomnia was 57%, with the majority being young adults (45), while the average European rate was lower (30.8% % IC, 27.1–34.4%) (46). This high prevalence of sleep disorders may be because they constitute a vulnerable group in continuous change due to maturation, academic and work processes (47). It is also a population that makes greater use of smartphones, the Internet, social networks and video games and presents greater substance use, factors that are closely linked to insomnia and anxiety (43, 48). The combination of sleep disorders with these types of addiction thus affects their quality of life (49).

For these reasons, the main objective of this study is to analyze the links between addictions and obesity, the distribution of body fat, physical activity, sedentary time, arterial stiffness and vascular aging, alongside sleep quality, cognitive function and gender differences in young adults.

The secondary objective is to analyze how the quality and quantity of sleep is associated with the appearance of addictions, obesity, level of physical activity, sedentary time, cognitive function and arterial stiffness, as well as differences by gender.

2 Methods and analysis

2.1 Study design and context

This is a descriptive observational study of cases and controls in which the differences between subjects with (cases) and without (controls) behavioral and/or drug addictions with obesity, physical activity, sedentary lifestyle, arterial stiffness and vascular aging, and the relationships between them, will be analyzed. The study will be carried out in the urban center of Salamanca, in the Primary Care Research Unit (APISAL), involving researchers from three groups of the IBSAL.

This project was approved by the Committee of ethics of research with medicines of the health area of Salamanca on 7/10/2021 (CEIm Reference Code Ref. PI 2021 088671048), and on 07/24/2023 (Reference Code CEIm reference Ref. PI 2023 071332). The SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) checklist 1/4/2024 11:04:00 a.m. is available for this protocol (Supplementary material 1).

2.2 Study population

An urban population from the health area of Salamanca will be recruited by means of stratified random sampling by age and sex groups with replacement, based on the individual health card (TIS), 500 subjects aged between 18 and 34 years will be selected.

Candidates will be invited to participated by phone, if they accept, the study visit will be scheduled according to their availability. They will be considered non-responsive if three calls are made in three different days at different times of the day (morning, noon and afternoon) and they do not answer.

Inclusion criteria: Patients between 18 and 34 years of age who agree to participate in the study and do not meet any exclusion criteria. Exclusion criteria: terminally ill subjects who are unable to travel to the health centers to undergo the corresponding examinations and who do not sign the consent form. The selected questionnaires will be used to determine whether the participant has any type of addiction.

The sample size was calculated with free GRANMO software[1] to detect a difference of 0.8 units in the Body Mass Index (BMI) between subjects who present or do not present any behavioral or substance addiction. A 1:3 ratio of people with addictions/non-addictions is estimated (1). Accepting an alpha risk of 0.05 and a beta risk of less than 0.2 in a bilateral contrast, 108 subjects are therefore needed in the first group and 360 in the second to detect a difference equal to or greater than 0.8 BMI units, assuming a common standard deviation of 2.16 BMI units (17). Therefore, the 500 subjects included will be sufficient to test the proposed hypotheses. The description of the

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[1] http://www.imim.cat/ofertadeserveis/software-public/granmo/

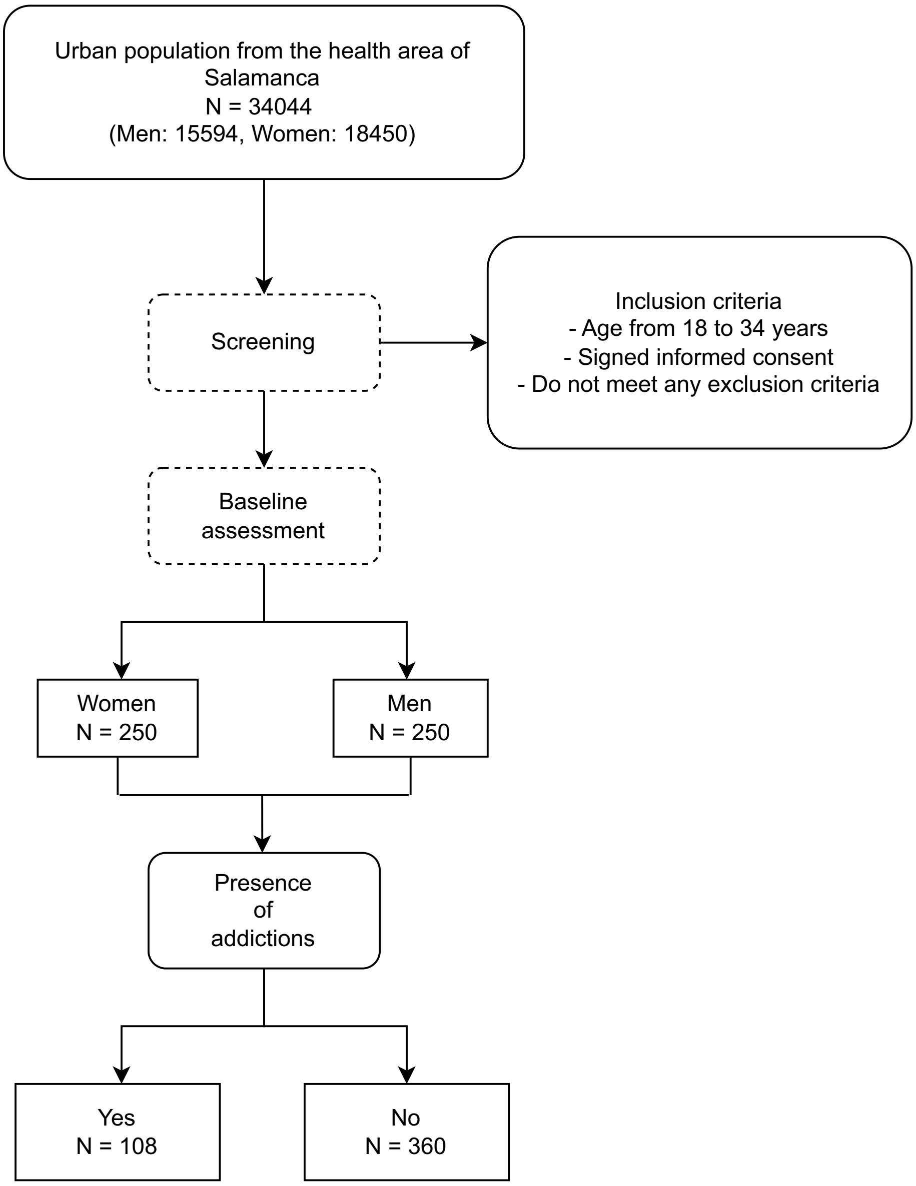

FIGURE 1
Study flowchart.

subjects included in this study is shown in Figure 1. At the end of the study, each patient will be sent a detailed report with the results of the tests performed. In addition, a dissemination session will be organized for all patients included in the study.

2.3 Variables and measurement instruments

All measurements shall be carried out within a maximum period of 8 days. Researchers collecting data shall be trained in advance following a standardized protocol and quality assessment shall be carried out by an independent researcher.

Table 1 shows the questionnaires and tests performed on the subjects during the study.

2.3.1 Sociodemographic variables and personal and family background

At the time of inclusion in the study, age, sex, marital status, educational level and current employment status will be collected. In addition, personal history of hypertension, hypercholesterolemia, thyroid problems or other diseases, drug use and whether they follow any special diet will be recorded. Direct family history of cardiovascular and cerebrovascular diseases will also be asked, as well as a history of drug use and addictions to gambling, mobile phones and/or social networks.

2.3.2 Addiction assessment

2.3.2.1 Behavioral addictions

The following addictions will be evaluated through questionnaires: *Betting with money* using the Cuestionario Breve de Juego Patológico

TABLE 1 **Summary of variables and form of measurement to be carried out in the study.**

Sociodemographic variables	
Age, sex, marital status, education level and employment	
Anthropometric variables	
Body weight, height, Body mass index, waist circumference, blood pressure	
Body composition	Inbody 230® multifrequency analyzer (Biospace)
Lifestyles	
Diet quality	Mediterranean Diet Adherence Screener (MEDAS)
Physical activity and sedentary time	International Physical Activity Questionnaire-Short Form (IPAQ-SF)
	Accelerometer (ActiGraph-GT3X)
	Marshall Sitting Questionnaire (MSQ)
Quality and quantity of sleep	Pittsburgh Quality Index (PSQI)
	Ford Insomnia Response to Stress Test
Behavioral addictions	
Gambling	Brief Questionnaire of Pathological Gambling.
	Lie/Bet Scale.
Internet use	Compulsive Internet Use Scale (CIUS)
Smartphone use	Smartphone Dependence and Addiction Scale (EDAS-18)
Video games use	Video Game Related Experiences Questionnaire (CERV)
Drugs use and abuse	
Smoking habits	4-item questionnaire adapted from the MONICA study (WHO)
	Fagerström test
Alcohol consumption	Questionnaire on alcohol consumption in the last 7 days
	Alcohol Use Disorders Identification Test (AUDIT)
Drug use	Alcohol, Smoking and Substance Involvement Screening Test (ASSIST V3.0)
	Drug Abuse Screening Test (DAST-20)
Vascular function and aging	
Carotid-femoral pulse wave velocity (cfPWV)	SphygmoCor device
Central augmentation index (CAIx)	SphygmoCor device
Cardio ankle vascular index (CAVI)	VaSera *VS*-2000® device
Brachial-ankle pulse wave velocity (baPWV)	VaSera *VS*-2000® device
Target organ injury	
Heart evaluation	ECG (General electric 5000)
Kidney evaluation	Serum creatinine, glomerular filtration rate and albumin-creatinine ratio
Cognitive alteration	
Cognitive function	Montreal Cognitive Assessment (MoCA) scale

(CBJP) (Short pathological gambling questionnaire) (50). This comprises four dichotomous items (yes/no) referring to gambling habits, feeling of guilt, inability to give up gambling, and use of household money for gambling. A score of 2 or more will be considered pathological gambling. The existence of problematic gambling will also be assessed with the Lie/Bet scale (51), consisting of two items, one referring to lies and the other to gambling; answering yes to both items will be considered problematic. *Internet use* will be assessed with the version of the Compulsive Internet Use Scale (CIUS) adapted to the Spanish population (52), validated for young people in this age range and with a cut-off score of 28. *Compulsive smartphone use* will be measured using the short version of the Escala de Dependencia y Adicción al Smartphone (EDAS-18) (Smartphone dependence and Addiction Scale) (53), validated in the adult population (54). *Videogame use* will be evaluated with the Cuestionario de Experiencias Relacionadas con Videojuegos (CERV) (Videogame-related Experiences Questionnaire) (55) which has two dimensions, one regarding negative consequences and the other about escapism. A score above 26 is considered to be potentially problematic for the user.

2.3.2.2 Substance addiction

To assess addiction to drugs, we will use the following questionnaires: *Alcohol, Smoking and Substance Involvement Screening Test (ASSIST V3.0)*, consisting of eight items related to the use of nine substances, categorized into three risk levels: "low (0–3 points)," "moderate (4–26 points)" and "high (27 points and above)" (56, 57). The Spanish version of the *Drug Abuse Screening Test (DAST-20)* (58) consists of 20 questions with dichotomous answers (Yes/No), with 5 as a cut-off score. *Alcohol Use Disorders Identification Test (AUDIT)* consists of 10 questions allowing discrimination between risky use (8–15 points), harmful use (16–19 points) and alcohol dependence (20 points or above) (59). Using a structured questionnaire, the number of alcoholic drinks consumed in the previous week will be recorded, the grams/week consumed will be estimated and the patient will be classified as abstinent, low risk, intermediate risk or high risk, according to Spanish Ministry of Health criteria (60) on tobacco and alcohol consumption. Smoking will also be assessed with the standard four-item questionnaire adapted from the WHO MONICA study (61). The assessment of nicotine dependence uses the Fagerström test, comprising six questions that allows discrimination between mild dependence (under 4 points), moderate (4–6 points) or severe (7 points or over) (62).

2.3.3 Anthropometric variables and blood pressure measurement

Height will be measured in cm with a calibrated measuring rod, with the patient inspiring, barefoot and with heels against the wall. Waist circumference shall be measured with a flexible tape measure, with the tape parallel to the floor above the iliac crests, at the end of expiration and with the patient standing upright and without clothing. The hip circumference shall be measured at the point of maximum circumference, passing through the greater trochanter of the two femurs. Body composition shall be measured by bioimpedance with the Inbody 230® multifrequency analyzer (Biospace) according to the manufacturer's instructions. Clinic blood pressure (BP) will be measured three times, using a validated Omron model M10-IT sphygmomanometer (Omron Healthcare, Kyoto, Japan). Measurements will be performed on the participant's dominant arm in a sitting position after at least 5 min of rest with an appropriately sized cuff, determined by measuring the upper arm circumference and following the recommendations of the European Society of Hypertension (ESH) (39).

2.3.4 Vascular function

Pulse wave analysis and carotid-femoral pulse wave velocity (VOPcf) with the Sphygmocor System®: with the patient in the supine position, the pulse wave in carotid and femoral arteries is analyzed, estimating the delay with respect to the ECG wave and calculating the VOPcf. Central and peripheral Augmentation index (AIx): with the patient seated and the arm resting on a rigid surface, pulse wave analysis is determined by a sensor in the radial artery, estimating the aortic pulse wave (63). CAVI and baPWV will be estimated with the *VaSera VS-2000* device *(Fukuda Denshi Co, Ltd, Tokio, Japón)* following the manufacturer's instructions. Only CAVI measurements obtained for at least three consecutive heartbeats will be considered valid (64). The baPWV will be estimated using the following equation: $\text{baPWV} = ((0.5934 \times \text{height(cm)} + 14.4724))/\text{tba}$, where tba is the time interval between the brachial and ankle waves (65). CAVI values will be divided into: normal (CAVI <8), normal-high ($8 \leq \text{CAVI} < 9$) and abnormal (CAVI ≥9) (64, 66).

2.3.5 Vascular aging

Vascular aging will be assessed using cfPWV, baPWV or vascular age, estimated by the *VaSera VS-2000* device *(Fukuda Denshi Co, Ltd, Tokio, Japón)* as measures of stiffness. Firstly, subjects with vascular injury (carotid artery injury or peripheral artery disease) will be classified as EVA. In a second step, VAS is defined if the cfPWV or baPWV values are higher than the 90th percentile (p); EVN if they are between p10 and p90 and EVS if the values are below p10 (67, 68).

2.3.6 Lifestyles

2.3.6.1 Diet quality

The quality of the diet will be assessed with the validated 14-item Mediterranean Diet Adherence Screener questionnaire (MEDAS) (69) developed by the PREDIMED project: it sets out 14 items. Adherence to the Mediterranean diet is considered if the total score is ≥9 points.

2.3.6.2 Physical activity and sedentary lifestyle

Physical activity will be assessed objectively for 7 days with the *ActiGraph-GT3X* accelerometer *(ActiGraph, Shalimar, FL)*, validated (70). The measurement includes daily step count, time and intensity of physical activity, and sedentary time in minutes per week for seven consecutive days. The intensity of physical activity (low, moderate or high) will be determined according to the cut-off points proposed by Freedson et al. (71). Intensity will also be measured subjectively with the *International Physical Activity Questionnaire-Short Form (IPAQ-SF)* (72). Sedentary behavior will be assessed with the *Marshall Sitting Questionnaire* (MSQ): it assesses daily sitting time in different activities: traveling or commuting, work/class, watching TV, using the computer at home and during leisure time (73).

2.3.7 Sleep quality and quantity

Pittsburgh Sleep Quality Index (PSQI): assesses sleep quality and sleep disturbances over a one-month interval. Nineteen individual items generate seven "component" scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep medication use and daytime dysfunction. The sum of the scores of these seven components results in an overall score. The cut-off point is 5, such that scores less than or equal to indicate good sleep quality, while higher values indicate poor sleep quality (74). The *Ford Insomnia Response to Stress Test* questionnaire to assess insomnia as a response to stress: it consists of nine questions about situations that can cause stress in the person and make it difficult to fall asleep (75).

2.3.8 Target organ injury

2.3.8.1 Kidney injury

The CKD-EPI formula: will be assessed with plasma creatinine, glomerular filtration rate estimated with the CKD-EPI formula (76), following the criteria of the ESC/ESH arterial hypertension management guidelines (39).

2.3.8.2 Cardiac injury

Cardiac lesion will be assessed with a *General electric 5,000*® digital ECG that automatically determines the voltage and wave duration, and estimates Cornell-Lyon and Cornell criteria to assess left ventricular hypertrophy (LVH) (39).

2.3.8.3 Cognitive assessment

The *Montreal Cognitive Assessment (MoCA)*, a dementia screening tool validated in Spain (77) will be performed. Of the total possible score is 30 points; a score of 26 or more is considered normal.

2.3.8.4 Analytical tests

Venous blood samples and urine samples will be taken between 08:00 and 09:00, with participants fasting, without smoking, drinking alcohol or caffeinated beverages, for the previous 12 h. On inclusion, an analysis will be performed to determine baseline blood glucose, urea, uric acid, creatinine, glomerular filtration rate estimated with the *CKD-EPI* equation, ionogram, thyroid function, lipid profile, blood count, liver profile, vitamin D and albumin-creatinine index. Samples will be taken in the APISAL Research Unit and sent by preferential internal delivery to the Clinical Analysis Service of the University Healthcare Complex of Salamanca in collaboration with the Biochemistry and Immunochemistry Section of the University Hospital of Salamanca. The samples will be coded and the laboratory techniques will be standardized.

2.4 Procedures

The investigators will phone potential candidates to participate in the study, explaining the purpose of the study. Those who agree to participate will be scheduled for an in-person visit, where they will be informed about the study and invited to sign the consent form. A fasting blood test will be performed at the same visit, as well as the rest of the test. Sociodemographic data, personal and family health history, smoking status, alcohol and drugs use, physical activity, sedentary time, Mediterranean diet, and cognitive evaluation will be collected. A clinical evaluation will be performed by recording blood pressure, height, weight, waist and hip circumference, body composition and vascular assessment tests. Finally, the accelerometer will be placed on the waist for 7 days and self-administered questionnaires will be given. The second visit will be arranged 8 days later for the return of both.

A report on the tests performed and the results of the analysis will be given to all participants. If any of the tests or questionnaires show altered results, patients will be referred to their family physician for follow-up, treatment or referral to the second level of care if necessary.

2.5 Statistical analysis

Data will be recorded using the REDCap platform (Research Electronic Data Capture) (78, 79) with a previously designed questionnaire. The normal distribution of the variables will be verified with the Kolmogorov–Smirnov test. Differences in means between variables in two categories will be carried out using a Student's *t*-test or a Mann–Whitney U-test, as appropriate, while qualitative variables will be analyzed using an X^2 test. To analyze the relationship between qualitative variables of more than two categories and quantitative variables, an analysis of variance will be used and in the *post hoc* analysis the LSD will be used. The Kruskal-Wallis test will be used in cases where the variables are not normally distributed. Analysis of covariance (ANCOVA) will be performed to adjust for variables that may affect the results as confounding factors. The relationship of the quantitative variables with each other will be tested using the Pearson or Spearman correlation, as appropriate. To analyze the relationship of the different addictions with obesity, physical activity, sedentary lifestyle and arterial stiffness, a multiple regression analysis will be performed. Logistic regression will be used to assess the association between having or not having addictions with obesity, physical activity, sedentary lifestyle and vascular aging, adjusted for possible confounding variables. Data will be analyzed using the statistical package SPSS Windows version 26.0. (IBM, Armonk, New York: IBM Corp.). A $p < 0.05$ will be considered statistically significant and in the case of multiple comparisons the Bonferroni correction will be done. The statisticians/researchers performing the different analyses will be blinded to the patient's clinical data. All variables will be analyzed disaggregated by sex, and where appropriate, differences will be analyzed from a gender perspective, as the influence of gender on numerous pathologies, particularly cardiovascular and cerebrovascular diseases, is well known.

3 Discussion

Behavioral and substance addictions have become progressively more prevalent (3), while in parallel, accelerated vascular aging has also occurred. Thus, finding relationships between behavioral and substance addictions with vascular stiffness and aging, as well as with sleep, physical activity, and cognitive impairment may shed light on this field in order to design future interventions for young adults.

Behavioral addictions, such as gambling, internet and cell phone use, and video games, are rising among young adults (1). They are associated with unhealthy lifestyles and increase health problems such as eye strain, tiredness, headaches and obesity, disrupt sleep quantity and quality, and cause withdrawal symptoms (anger and irritability) and even substance abuse due to compulsive disorder, leading to mental health problems (4, 5). Thus, the increased use of smartphones is closely linked to low self-esteem and the need for self-control, which is why adolescents seek support on social networks as a stress coping mechanism to alleviate depression and anxiety (80). The time spent on screens has risen progressively, as has the prevalence of gaming disorder, in parallel with the increase in substance use (81, 82). These facts mean more sedentary time and, therefore, less physical activity (83), greater obesity (19, 84), worse sleep quality and quantity (85), all of which are risk factors for accelerated vascular aging.

Meanwhile, substance addictions are linked to lifestyle in various ways. Thus, lifestyles can influence the development of a substance addiction, and in turn, addiction can affect and modify lifestyles. One study has shown how participants with unhealthy lifestyles were associated with substance use (86). Moreover, some substances, such as alcohol, are a risk factor for obesity (87). Substance addictions, especially those that affect the cardiovascular system, have a significant impact on vascular aging. Using cocaine or amphetamines increases blood pressure and in turn can accelerate vascular aging (88). Smoking also accelerates vascular aging (68). Excessive and chronic alcohol use contributes to premature aging of blood vessels (89) and many substances, including some illicit substances, can generate oxidative stress and an inflammatory response in the cardiovascular system, increasing vascular aging (90). In summary, substance addictions can increase the risk of developing cardiovascular diseases such as hypertension, coronary heart disease and stroke, diseases which are related to vascular aging and can accelerate the deterioration of blood vessels. Finally, it must not be forgotten that polydrug use increases risks, heightening the effects of some substances on others, reinforcing addiction, interfering with diagnosis, making treatment difficult and increasing mental illnesses (10).

In conclusion, all of the above makes it necessary to carry out studies which relate the presence of addictions, both behavioral and substance, to the increase in obesity and sedentary lifestyle, reduced physical activity, sleep patterns, and accelerated vascular aging. The results of this project will allow us to better understand the situation regarding behavioral and substance addictions in young adults in the urban health area of Salamanca. In addition, it will analyze how addictions are linked to lifestyles, arterial stiffness and vascular aging, being to the best of our knowledge the first study to analyze the relationship between addictions and vascular aging in a sample of young adults, as well as the effects they have on obesity and lifestyles. The evidence generated will thus allow the development of preventive/therapeutic strategies to modify lifestyle from an early age and thus contribute to healthy vascular aging. All of this will allow us to learn which participant profiles are at highest risk of accelerated vascular aging so that this can be transferred to clinical practice. This can contribute to the development of personalized medicine, adapting preventive/therapeutic interventions to each user, thus generating an individual approach, based on the specific characteristics of each person.

The main limitations of the study are: firstly, since it is a random sample collected in the urban area of Salamanca, the data cannot be extrapolated to the rural population. Secondly, causality cannot be assumed as it is a cross-sectional study, but associations can be analyzed and hypotheses generated for future prospective etiological studies with a larger sample of subjects. On the other hand, this project also has strengths in that it is the first that attempts to link addictions to lifestyle and accelerated vascular aging in a young adult population, and its results will allow evidence to be generated for the design of preventive interventions in this age range.

4 Brief summary

Behavioral and substance addictions affect a significant percentage of the population between the ages of 18–34. Likewise, obesity and unhealthy lifestyles such as decreasing physical activity and increasing sedentary time, mostly spent in front of screens, plus a rise in the consumption of processed foods, are increasing in this population group. These factors are related to disturbed sleep quantity and quality, increased obesity, and may be related to arterial stiffness and early vascular aging.

For the above reasons, we propose this study with the main objective of analyzing the association of addictions with obesity and the distribution of body fat, physical activity, sedentary time, arterial stiffness and vascular aging, sleep quality and cognitive function, and gender differences in young adults aged between 18 and 34. Studying all these variables assessed with validated questionnaires or validated objective examinations or tests will allow us to identify people with a higher risk of presenting behavioral addictions or substance addictions. A deeper knowledge of all these health problems and the relationship between them can facilitate the development of personalized medicine, adapting preventive/therapeutic interventions with an individual approach and early and appropriate clinical support.

5 Ethics and dissemination

5.1 Ethical approval and consent for participation

The study was approved by the Committee of ethics of research with medicines of the health area of Salamanca on 7/10/2021 (CEIm reference code Ref. PI 2021 088671048), and 24/07/2023 (CEIm reference code Ref. PI 2023 071332). Before the start of the study, all participants will sign the informed consent (Supplementary material 2). During the development of the study, the standards of the Declaration of Helsinki (91) and the WHO guidelines for observational studies will be followed. Subjects will be informed of the objectives of the project and the risks and benefits of the explorations to be carried out. The study does not contemplate any intervention entailing a risk greater than the minimum involved in carrying out the different tests. All information generated in this study will be stored, encrypted and used exclusively for the purposes specified here. Both the samples and the data collected will be associated with a code and stored under appropriate security conditions, and participants are guaranteed that they cannot be identified through means considered reasonable by persons other than those authorized. The confidentiality of the participants included will be guaranteed at all times in accordance with the provisions of Organic Law 3/2018, December 5, regarding the Protection of Personal Data and guarantee of digital rights and Regulation (EU) 2016/679 of the European Parliament and of the Data Protection Council of April 27, 2016 (GDPR).

The participants will not receive any compensation for the visit completion. They will receive a report of tests performed on the state of their health status.

5.2 Dissemination plan

The data will be available to the members of the research group, who will be mainly responsible for dissemination. In addition, the variables used in each manuscript will be available to the entire scientific community through the Gredos scientific repository of Salamanca University. The results of the study will be published in peer-reviewed open access scientific journals, to be complemented by the presentation of the study results at national and international scientific conferences. Likewise, suitable dissemination will be carried out through social networks, information days for citizens, in other media and directly to those participating in the study. Current and future knowledge of the relationship between addictions and lifestyle, and how this relationship affects accelerated vascular aging in young adults will be transferred to clinical practice.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by The Ethics Committee for Research with Medicines of the Salamanca Health Area. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

SV-G: Writing – original draft. CL-S: Writing – original draft. OT-M: Writing – review & editing. AV: Writing – review & editing. SG-S: Writing – review & editing. SC: Writing – review & editing. MG-S: Writing – review & editing. ER-S: Writing – review & editing. LG-O: Writing – review & editing. LG-S: Supervision, Writing – review & editing. MG-M: Supervision, Writing – review & editing. EVA-Adic Investigators Group: Investigation, Writing – review & editing.

EVA-Adic Investigators Group

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1322437/full#supplementary-material

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Glossary

ANOVA	Analysis of variance
APISAL	Primary Care Research Unit of Salamanca
AS	Arterial stiffness
ASSIST	The Alcohol, Smoking and Substance Involvement Screening Test
AUDIT	Alcohol Use Disorders Identification Test
baPWV	Brachial-ankle pulse wave velocity
BMI	Body Mass Index
BP	Blood Pressure
CA	Cardiovascular aging
CAIx	Central augmentation index
CAUSA	Complejo Asistencial Universitario de Salamanca
CAVI	Cardio-ankle vasculat index
CBJP	El Cuestionario Breve de Juego Patológico
CEIm	Comité de Ética Investigación con Medicamentos
CERV	The Questionnaire of Experiences Associated with Video games
cfPWV	Carotid-femoral pulse wave velocity
CIUS	Compulsive Internet Use Scale
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration
DAST	Drug Abuse Screening Test
DP	Diastolic pressure
EDAS	Escala de dependencia y adicción al smartphone
EDADES	Encuestas sobre Alcohol y Otras Drogas en España
EKG	Electrocardiogram
ESH	European Society of Hypertension
EU	European union
EVA	Early vascular aging
GRS	Gerencia Regional de Salud
HVA	Healthy vascular aging
ISCIII	Instituto de Salud Carlos III
IBSAL	Instituto de Investigación Biomédica
IPAQ	International physical activity questionnaire
LVH	Left ventricular hypertrophy
MEDAS	Mediterranean Diet Adherence Scale
MET	Equivalentes metabólicos de tarea
MoCA	Montreal Cognitive Assessment
MRR	Facility for Recovery and Resilience
MSQ	Marshall Sitting Questionnaire
NVA	Normal vascular aging
OMS	Organización Mundial de la Salud
PDV	Product of Duration by Voltage
PREDIMED	Prevención con Dieta Mediterránea
PSQI	Pittsburgh's sleep quality index
RGPD	Reglamento de Protección de Datos
RICAPPS	Network of Research in Chronicity, Primary Care and Health Prevention and Promotion
SP	Systolic pressure
SPIRIT	Standard Protocol Items Recommendations for Interventional Trials
TBA	Time interval between arm and ankle waves
TSI	Tarjeta Sanitaria Individual

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Pilot trial results of D-HOMES: a behavioral-activation based intervention for diabetes medication adherence and psychological wellness among people who have been homeless

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Introduction: People living with type 2 diabetes who experience homelessness face a myriad of barriers to engaging in diabetes self-care behaviors that lead to premature complications and death. This is exacerbated by high rates of comorbid mental illness, substance use disorder, and other physical health problems. Despite strong evidence to support lay health coach and behavioral activation, little research has effectively engaged people living with type 2 diabetes who had experienced homelessness (DH).

Methods: We used community engaged research and incremental behavioral treatment development to design the Diabetes HOmeless MEdication Support (D-HOMES) program, a one-on-one, 3 month, coaching intervention to improve medication adherence and psychological wellness for DH. We present results of our pilot randomized trial (with baseline, 3 mo., 6 mo. assessments) comparing D-HOMES to enhanced usual care (EUC; brief diabetes education session and routine care; NCT05258630). Participants were English-speaking adults with type 2 diabetes, current/recent (<24 mo.) homelessness, and an HbA1c$\geq$7.5%. We focused on feasibility (recruitment, retention, engagement) and acceptability (Client Satisfaction Questionnaire, CSQ-8). Our primary clinical outcome was glycemic control (HbA1c) and primary behavioral outcome was medication adherence. Secondary outcomes included psychological wellness and diabetes self-care.

Results: Thirty-six eligible participants enrolled, 18 in each arm. Most participants identified as Black males, had high rates of co-morbidities, and lived in subsidized housing. We retained 100% of participants at 3-months, and 94% at 6-months. Participants reported high satisfaction (mean CSQ-8 scores=28.64 [SD 3.94] of 32). HbA1c reduced to clinically significant levels in both groups, but we found no between group differences. Mean blood pressure improved more in D-HOMES than EUC between baseline and 6 mo. with between group mean differences of systolic -19.5 mmHg ($p=0.030$) and diastolic blood pressure -11.1 mmHg ($p=0.049$). We found no significant between group differences in other secondary outcomes.

Conclusion: We effectively recruited and retained DH over 6 months. Data support that the D-HOMES intervention was acceptable and feasible. We observe preliminary blood pressure improvement favoring D-HOMES that were statistically and clinically significant. D-HOMES warrants testing in a fully powered trial which could inform future high quality behavioral trials to promote health equity.

Clinical trial registration: https://clinicaltrials.gov/study/NCT05258630?term=D-HOMES&rank=1, identifier NCT05258630.

KEYWORDS

diabetes, health equity, homelessness, behavioral trials, behavioral activation

1 Introduction

Robust evidence ties social risks to persistent health inequities in premature morbidity and mortality due to diabetes (1). Homelessness is defined in the U.S. by the HEARTH Act and includes a dynamic spectrum including people staying in shelters, sleeping outside "or other places not meant for human habitation," or who will imminently lose their housing (2). Homelessness is a key social risk that results in higher rates of diabetes-related complications and hospitalization (3, 4), and premature mortality compared to stably housed people (5). Homelessness presents substantial barriers to diabetes self-care, access to health care and prescription medications, managing psychological wellness and mental health, and affording and prioritizing diabetes care amidst other competing demands (6–8). Furthermore, homelessness has known association with premature morbidity and mortality (9), premature aging (10), and high rates of co-morbidities including trimorbidity, or the overlap of physical, mental health, and substance use conditions (11). Finally, the disproportionate impact of homelessness on people of color has deep roots in structural racism and may be a key driver of persistent racial/ethnic disparities in diabetes outcomes (12, 13).

Robust investment has yielded increasing evidence about how to deliver effective support to people living with diabetes (14, 15). A meta-analysis found that self-management education can reduce all-cause mortality in people with type 2 diabetes (16). Numerous one-on-one lay health coaching programs improve glycemic control in low resource environments (17–19). Strong evidence also supports approaches to co-manage diabetes and mental illness (20–22). While interventions to improve medication adherence across various diagnoses have not historically yielded conclusive evidence (23), growing literature suggests that behavioral activation techniques can effectively improve medication adherence and psychological wellness in populations facing resource constraints (24–26). Yet too often people living with type 2 diabetes who have experienced homelessness cannot access clinical trials or supportive programs for diabetes.

We sought to fill that gap by using community engaged research and incremental behavioral treatment development (27) to create a behavioral intervention tailored to the unique needs of people living with type 2 diabetes who have experienced homelessness. Guided by a team of people with lived experience and a treatment model based on the Information-Motivation-Behavioral Skills model (28), we conducted preliminary qualitative work with patients and housing and health care providers which revealed high desire and initial feasibility for a lay health coaching program focused on medication adherence and psychological wellness for people who had experienced homelessness with type 2 diabetes (29). Our community engaged research team, the Quorum for Community Engaged Wellness Research (Quorum), included people who had gained knowledge through lived experience of homelessness and diabetes, a community engaged research facilitator, and housing and health care providers. The Quorum guided all phases of this research to develop the Diabetes Homeless Medication Support (D-HOMES) program.

In this paper we present findings from our pilot randomized control trial comparing D-HOMES to enhanced usual care (EUC; one-time, brief diabetes education and encouragement to access existing clinical supports in our area). We report on feasibility, acceptability, and preliminary efficacy of clinical and behavioral outcomes.

2 Methods

2.1 Design

We conducted a two-arm, single blinded, randomized pilot trial comparing the feasibility, acceptability, and preliminary efficacy of D-HOMES versus EUC. We registered this trial at ClinicalTrials.gov (NCT05258630) and got approval by our Institutional Review Board. The first participant enrolled on February 23, 2022, and the last participant enrolled on January 27, 2023. While we could not blind coaches or participants, blinded staff collected all assessment data at baseline, 3-month, and 6-month time points. We conducted the study in an urban, Midwestern city in the United States. We compensated participants for each assessment visit ($150 total if all visits completed). We offered travel support with bus tokens, parking vouchers, or cab rides when needed. We also provided $20 per month to participants in both conditions who maintained a valid phone number to support cell phone charges. A participant who maintained a valid phone number could earn up to $120 across their 6 months in the study. We implemented this phone access incentive in response to feedback in previous studies indicating that many participants used “pay as you go” phones and/or had limited monthly cell phone minutes that were used up by study logistics. Note that we did not provide reimbursement for completing treatment sessions.

The Quorum team predates this trial and is ongoing currently. This team combines people with lived experience, researchers, and service providers in health care and housing. The team advised and monitored all stages of this trial. They impacted decisions including amount of compensation, presentation of informed consent using a clear infographic (29), the ethics of our comparison group, and reviewed all adverse events.

2.2 Participants

We set inclusion criteria of age 18 years or older, English-speaking, experience of homelessness in the past 24 months (per HEARTH Act) (2), self-reported diagnosis of type 2 diabetes verified in health record, HbA1c≥7.5% via study laboratory testing or clinical lab result in the last 30 days, plan to be reachable for the next 6 months, and willingness to work on medication adherence and diabetes self-care. Exclusion criteria were prior participation in earlier D-HOMES studies, inability to provide informed consent (e.g., presence of a legal guardian, active psychosis, or intoxication), and current pregnancy or lactation.

We attempted a variety of recruitment methods in this pilot trial. This included screening people with type 2 diabetes and evidence of homelessness in their medical records using a homelessness flag based on previous work by our team (30). We requested referrals from medical and behavioral health providers at area safety net clinics including Health Care for the Homeless, a national program offering clinical services to people experiencing homelessness (31). We also built partnerships with several local shelter and supportive housing providers for additional referrals, attempted outreach (e.g., tabling events), and we posted flyers in shelters, bus stops, drop-in centers, and local libraries.

We conducted telephone screening with interested participants who we invited to complete a two-part enrollment/baseline assessment process. The first visit included the informed consent process and collected initial demographic and related assessments and drew blood to confirm eligible HbA1c values. We invited for a second visit those with HbA1c values meeting inclusion criteria (or results completed in the last 30 days at a certified medical laboratory that we could see in electronic health records). During the second visit, participants completed remaining assessments. Participants then met with intervention coaches who completed randomization and initiated treatment conditions.

2.3 Randomization and intervention

A randomization scheme built into REDCap (32, 33) assigned participants to D-HOMES or enhanced usual care (EUC) using permutated block randomization. We randomized in a 1:1 ratio using small random sized blocks (with 2-4 participants per block).

2.3.1 Diabetes homeless medication support

We detailed the development steps and treatment content of the Diabetes Homeless Medication Support (D-HOMES) program in a separate publication including our treatment model (29). Briefly, D-HOMES coaches used behavioral activation (BA) to work with participants to set weekly, personalized goals to improve medication adherence and psychological wellness (34). They offered participants in-person and telephone meetings for approximately 30 minutes weekly for up to 10 sessions from month 0-3 and up to 3 monthly 10-15 minute booster calls from months 4-6. Throughout treatment, coaches provided diabetes education on the topics and in formats desired by the participants and encouraged them to have and use a regular source of health care to support diabetes management, maintain prescriptions, and address any medication side effects. Initial sessions used a values exercise to identify sources of meaning and motivation specific to each participant. Coaches also explored potential connections between the participant’s values and diabetes management and returned to these connections throughout coaching to support motivation for diabetes management. Goal setting started in session 2 and focused on blood sugar control goals (mostly diabetes pill medication adherence, but also adherence to injectable medications including insulin, recommended blood sugar checks, and the interaction of diet and physical activity with blood sugar) and psychological wellness. For most participants, working on adherence to daily diabetes pill medication overlapped with daily adherence to other medications (e.g., blood pressure, cholesterol, and mental health). At sessions 3-5, coaches worked with each participant to choose one personalized commercially available tool (approximately $20 value) to support medication adherence, e.g.) pill organizer, notebook to record blood sugar levels, zipped pouch to store medications and glucometer. Booster calls reinforced goal-setting focused on reinforcing diabetes medication adherence. Throughout treatment, coaches provided referrals to area Health Care for the Homeless clinics and other homelessness and behavioral health services as needed.

2.3.2 Enhanced usual care

Following the Pragmatic Model for Comparator Selection in Health-Related Behavioral Trials and with input from the Quorum team, we designed an enhanced usual care (EUC) comparator. This aligned with our study's purpose, the phase of our research, and the real-world context and ethical issues of diabetes care for people who have experienced homelessness (35).

In EUC, the same coaches (OOP, JC) delivered one brief (approximately 15 minute), instructional diabetes education session to participants. They read the content of 3 handouts focused on (i) what is type 2 diabetes, (ii) healthy eating, and (iii) physical activity when living with diabetes used in a previous trial of people with diabetes from a low-income, urban area in the U.S (36–38). They also encouraged participants to use a regular source of health care to support diabetes management and supported participants to access such care if not already present. Coaches provided a resource page with area medical and behavioral health providers and homelessness resources to all participants.

2.3.3 Interventionist training and fidelity monitoring

Coaches (OOP, JC) trained for approximately 22 hours in BA, motivational interviewing, homelessness and expected comorbidities, as well as diabetes. Each coach completed self-rated fidelity checklists after each visit in both arms. To establish supervisor rated fidelity, the PI (KDV) reviewed 35% of audio recordings of D-HOMES treatment sessions and completed the same session checklist. Weekly supervision meetings (led by KDV and AMB) supported coaching and ensured timely re-training for any departures from the protocol or treatment manual.

2.4 Feasibility and acceptability

Given the lack of prior longitudinal behavioral trials in this population, we primarily sought to establish feasibility and acceptability in this pilot trial. We measured feasibility by tracking the recruitment and retention rates demonstrating the study team's ability to connect with participants and follow the trial protocol. We measured acceptability with treatment engagement measures and the 8-item Client Satisfaction Questionnaire (CSQ-8). Each item is scored on a 4-point Likert like scale resulting in a range of scores from 8-32 higher scores indicating higher satisfaction (39, 40). We also collected fidelity data about the team's ability to follow the treatment manual and study protocol (See 2.3.3).

2.5 Outcomes

Note that we labeled HbA1c as our "primary clinical outcome" because it is the primary outcome of interest in this line of work, however, this clinical trial is not powered for HbA1c. Likewise, we label medication adherence as our "primary behavioral target," but we do not have power to detect differences in medication adherence. Thus, outcome results on our primary (and secondary) outcomes should be considered preliminary.

2.5.1 Primary clinical outcome

Our primary clinical outcome was glycemic control measured by hemoglobin A1c (HbA1c). This widely used measure provides an estimated average glucose level across the past 3 months (41). HbA1c over 6.5% diagnoses diabetes (42) and clinical guidelines recommend each patient set an individualized goal with their health care provider based on a variety of factors (43). A change of 0.5% in HbA1c is considered clinically meaningful (44). We began measuring HbA1c using fingerstick samples from participants collected by research staff and transitioned to using serum samples collected in a certified medical lab due to multiple clotted specimens and participant preference for venipuncture. Our fingerstick specimens were processed using the DCA Vantage point-of-care machines (45); our venipuncture specimens were processed using the Sebia Capillarys Flex analyzer (46).

2.5.2 Primary behavioral outcome

We found no research to inform the appropriateness of self-report medication adherence scales in this population, thus we collected self-reported medication adherence in multiple ways in this pilot to inform our choice of instrument for a future, larger trial. We measured medication adherence specific to diabetes using the Adherence to Refills and Medicines Scale for Diabetes, on which scores range from 11-44, with higher scores indicating more problems with adherence [ARMS-D; Mayberry et al., (47)]. We also used the glucose subscale of the Diabetes Self-Management Questionnaire (DSMQ) where total and subscale scores are transformed onto a 0 to 10 scale with higher scores indicating better self-management behaviors. A "not applicable" option allows some items to be excluded from the scale, e.g., for people who are not prescribed blood glucose checks (48). We measured overall medication adherence using the 12-item Adherence Starts with Knowledge (ASK-12) scale which allows a score range of 12-60 with higher scores indicating more barriers to adherence (49). We included an extra question from the 20-item ASK scale that uses a Likert-like agreement scale about alcohol use interfering with medication adherence (50). We adapted our own question about use of drugs ("My use of drugs gets in the way of taking my medicines."). We report on results of these added alcohol and drug interference questions separately from the standard scales.

2.5.3 Secondary outcomes

We measured psychological wellness with the 5-item Mental Health Inventory (MHI-5), a brief transdiagnostic screening tool attuned to broader concepts of wellbeing and distress than other available measures. MHI-5 scores are computed and transformed on a 0 to 100 point scale with higher scores indicating more wellness (51). We also included the 5-item Problem Areas in Diabetes (PAID-5) scale which results in scores from 0 to 20 with higher scores indicating more distress (52). Finally, we collected the diet, physical activity, and health care use subscales of the Diabetes Self-Management Questionnaire [DSMQ; Schmitt et al., (48)]. The DSMQ is an 16-item instrument which asks questions about a variety of behaviors related to diabetes self-management. We found it to be more appropriate for our population than other commonly used measures which reference employment and things done “around the house” (53).

Given the known importance of weight and blood pressure on long-term outcomes of people living with type 2 diabetes, we also measured Body Mass Index (BMI, weight divided by height squared) and blood pressure using standard instruments and protocols (54).

Given prior work by our team and others documenting high rates of substance use among people experiencing homelessness (11, 55, 56), we used an adapted version of the ASSIST tool to document types and frequency of use of tobacco, alcohol, and other drugs (57).

2.6 Statistical analysis

We planned an intention-to-treat approach and prespecified our statistical endpoints while recognizing we are not recruiting a sample size large enough to be fully powered on any outcome in this pilot trial. We set a two-tailed significance level (alpha) of 5% for our findings. We used R to summarize REDCap data extracts for presentation and calculate scores according to published literature. We used mixed-effects linear models with fixed effects terms for intervention, assessment time point, and intervention-by-time point interaction, and a random effect term for participant to account for within-participant correlation across visits. We examined the treatment effect by testing the interaction terms for the 3- and 6-month visits with baseline visit treated as the reference level. Linear mixed models provide unbiased estimation of the treatment effect in the presence of missing outcome data under the missing random assumption. We summarize results using means with 95% confidence intervals and p-values from these models. Analyses were conducted using R version 4.2.2 (58).

3 Results

3.1 Feasibility and acceptability outcomes and sample characteristics

From February 23, 2022 to January 27, 2023 we initiated screening with 96 people, fully screened 52 participants (4.7 per month) and enrolled 36 eligible participants (3.3 per month). We found screening people with upcoming medical visits with evidence of diabetes and homelessness in their medical records to be our most effective recruitment strategy (n = 24). Letters to people with diabetes diagnosis and evidence of homelessness (n=6); flyers posted in homeless shelters, service centers, public libraries, and bus stops (n = 3); and direct referrals from housing (n=2) and medical providers (n=1) also resulted in some eligible participants. Outreach (tabling) efforts at homeless drop-in centers and housing facilities did not result in any eligible participants. At the 3 month assessment 100% of eligible participants provided primary clinical outcome data (HbA1c), and 94% provided this data at the 6 month assessment (Figure 1).

The majority of our final eligible sample of 36 participants identified as Black, non-Hispanic males with a mean age 52 years and were prescribed a mean of approximately 6 medications each (Table 1). Homeless experiences varied with most participants currently living in subsidized housing (transitional or supportive) or staying at homeless shelters for the majority of the 30 days prior to enrollment. Participants reported high mean counts of lifetime homeless episodes (D-HOMES 4.2 [SD 5.6], EUC 2.4 [SD 1.7]). Participants reported high rates of co-morbidities with high blood pressure, high cholesterol, depression, anxiety/panic disorder, and post-traumatic stress disorder being the highest reported comorbidities. They also had high rates of traumatic brain injury, bipolar disorder, and schizophrenia/schizoaffective disorder. Participants reported high rates of substance use especially tobacco and alcohol, and 2 participants reported prior lifetime overdoses.

Participants demonstrated high treatment engagement in the D-HOMES intervention, suggesting good acceptability. D-HOMES participants completed an average of 8.7 coaching sessions (of 10 offered). Most participants randomized to D-HOMES (n=13/18) received all 10 sessions. Participants set an average of 2.5 goals/session and reported completing 73.8% of goals set. D-HOMES participants reported a mean score of 29.06 (SD 4.26, range 17, 32) on the Client Satisfaction Questionnaire indicating high satisfaction with the D-HOMES intervention. Those in the EUC condition reported a mean Client Satisfaction Questionnaire score of 28.22 (SD 3.66, range 22, 32) indicating high satisfaction with the EUC education intervention.

Fidelity checks revealed that coaches followed the treatment manual and study protocol for D-HOMES and EUC arms. EUC self-ratings revealed 100% fidelity to the protocol. D-HOMES checklists demonstrated high fidelity in both self-ratings (97.8%) and supervisor ratings (96.9%).

3.2 Outcome analyses

3.2.1 Primary clinical outcome

We found no between group differences in mean HbA1c change over time (Figure 2; Table 2). We note that both D-HOMES and EUC participants experienced a clinically significant (>0.5%) reduction in mean HbA1c from baseline to 3 months (D-HOMES -0.6% [SD 2.4%], EUC -0.8% [SD 2.5%]) and maintained that reduction through 6 months (baseline to 6 months mean change: D-HOMES -0.6% [SD 2.7%], EUC -0.8% [SD 2.5%]).

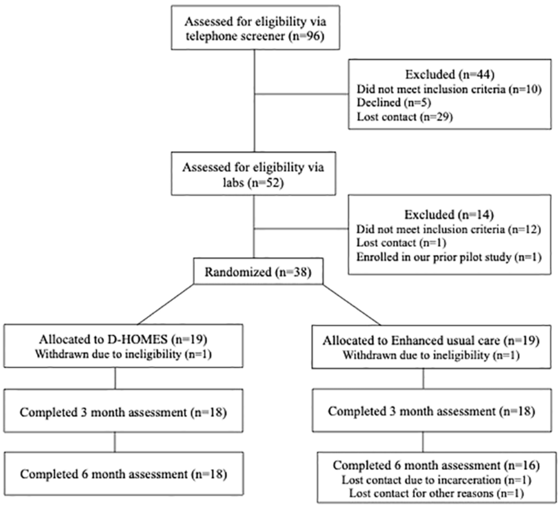

FIGURE 1
Recruitment and retention of participants in the D-HOMES pilot trial.

3.2.2 Primary behavioral outcome

We observed a skewed score distribution on our measure of diabetes specific medication adherence (ARMS-D) at baseline with significant ceiling effects (Table 2). The mode ARMS-D score at baseline was 11 (n = 7; 22% of sample), meaning no self-reported problems with adherence, and 18 participants (50% of sample) reported a score of 15 or less (rare adherence problems) at baseline. This allowed for little improvement over time. We did not observe any significant between group effects over time on the ARMS-D.

The glucose subscale of the DSMQ demonstrated a better array of scores (Table 2) with fewer ceiling effects. Glucose subscale scores improved somewhat in both groups, although we saw slightly more mean change in the D-HOMES vs. EUC (baseline to 3 mo. between group difference in change: 1.0 [95% CI -0.3, 2.4], baseline to 6 mo. between group difference in change: 1.0 [95% CI -0.4, 2.4]).

Overall medication adherence as measured by ASK-12 total scores demonstrated little change across time points among our participants. A significant minority of participants (16.7% in D-HOMES and 22.2% in EUC) reported that drugs and/or alcohol interfered with medication adherence; however, we found no significant between group mean differences in drug/alcohol interference over time.

3.2.3 Secondary outcomes

We report all secondary outcome data in Table 2. Participants demonstrated low levels of psychological wellness (MHI-5) and high levels of diabetes distress (PAID-5), but there were no significant between group differences on either scale. The remaining 3 DSMQ subscales showed no significant between group differences. Mean BMI was in the obese range (30–34, 36–41) for both D-HOMES (31.6) and EUC (36.8) groups at baseline, and BMI showed no significant between group differences over time.

TABLE 1 Demographic, social, and medical characteristics of pilot trial participants.

n (%) unless otherwise specified	D-HOMES	EUC
N	18	18
Age (mean years, SD)	52.2 (10.2)	51.9 (10.8)
Gender[@]		
Female	5 (27.8)	6 (33.3)
Male	13 (72.2)	12 (66.7)
Race^		
Black	16 (88.9)	13 (72.2)
White	1 (5.6)	2 (11.1)
Other	2 (11.1)	3 (16.7)
American Indian	1 (5.6)	1 (5.6)
Native Hawaiian or Pacific Islander	1 (5.6)	0
Hispanic Ethnicity (yes)	1 (5.6)	1 (5.6)
Number of prescribed medications[#] (mean, SD)	5.9 (2.5)	6.4 (2.1)
Education		
Less than high school	6 (33.3)	6 (33.3)
High school graduate/GED	6 (33.3)	3 (16.7)
Some college/technical degree/ Associate degree	6 (33.3)	8 (44.4)
College graduate (BA or BS)	0 (0.0)	1 (5.6)
Health insurance		
Insurance through exchanges	2 (11.1)	1 (5.6)
Medicaid or MinnesotaCare	9 (50.0)	7 (41.2)
Medicare	3 (16.7)	2 (11.8)
Other	4 (22.2)	6 (35.3)
Don't know	0	1 (5.6)
Missing	0	1 (5.6)
Housing at enrollment, majority in the past 30 days		
Homeless shelter	5 (27.8)	2 (11.1)
Someone else's apartment/room/house	1 (5.6)	1 (5.9)
Own apartment/room/house with subsidy	7 (38.9)	7 (38.9)
Own apartment/room/house without subsidy	1 (5.6)	6 (35.3)
Halfway house, residential treatment (drug/alcohol) program	1 (5.6)	0
Transitional housing	1 (5.6)	1 (5.6)
Other	2 (11.1)	0
Missing	0	1 (5.6)

(Continued)

TABLE 1 Continued

n (%) unless otherwise specified	D-HOMES	EUC
Housing at enrollment, majority in the past 30 days		
Count of lifetime homeless episodes,* 30+ days (mean, SD)	4.2 (5.6)	2.4 (1.7)
Co-morbidities,^ told by health care professional		
High blood pressure	9 (50.0)	12 (66.7)
High cholesterol	11 (61.1)	10 (55.6)
Depression	10 (55.6)	9 (50.0)
Anxiety/panic disorder	7 (38.9)	9 (50.0)
Post-traumatic stress disorder (PTSD)	6 (33.3)	7 (38.9)
Arthritis	5 (27.8)	7 (38.9)
Asthma	7 (38.9)	3 (16.7)
Emphysema or COPD or chronic bronchitis	2 (11.1)	4 (22.2)
Heart disease	1 (5.6)	2 (11.1)
Liver problems	0	1 (5.6)
Traumatic Brain Injury (TBI)	1 (5.6)	0
Bipolar disorder	6 (33.3)	2 (11.1)
Schizophrenia/Schizoaffective	5 (27.8)	1 (5.6)
None	1 (5.6)	1 (5.6)
Reported substance use,^ any in past 3 months		
Tobacco#	8 (44.4)	11 (64.7)
Alcohol	7 (38.9)	13 (72.2)
Cannabis#	5 (27.8)	7 (41.2)
Cocaine&	2 (11.1)	3 (18.8)
Amphetamine	2 (11.1)	0
Inhalant	0 (0.0)	1 (5.6)
Sedatives	6 (33.3)	3 (16.7)
Opioids	1 (5.6)	1 (5.6)
History of overdose	0	2 (11.1)

[@] "Non-binary or other" response also offered, not reported by any participants.
^Multiple answers per participant allowed for this item.
[#] 1 participant with missing data.
[&] 2 participants with missing data.
*3 participants with missing data.

Mean blood pressure at baseline was 138.1/84.1 among D-HOMES participants and 131.6/82.3 among EUC participants (Table 2). We observed a significantly larger reduction in systolic blood pressure from baseline to 6 months in D-HOMES (-11.9mmHg) vs EUC (+7.5mmHg); (Figure 3; Table 2). We observed a significantly larger reduction in diastolic blood pressure from baseline to 6 months in D-HOMES (-6.6 mmHg [SD 15.7]) vs EUC (+4.5 mmHg [SD 21.6]) (Figure 3; Table 2).

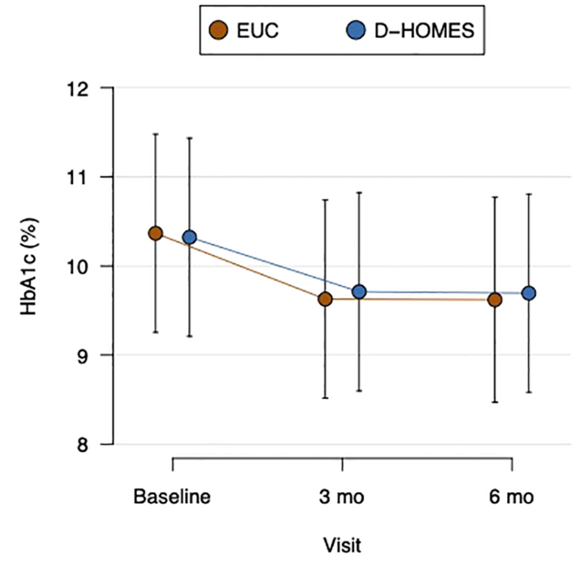

FIGURE 2
Change in glycemic control (HbA1c) in D-HOMES and enhanced usual care.

3.3 Adverse events

We actively tracked adverse events throughout this trial and reviewed them per protocol. One participant had an amputation during the study, which we reported to the IRB who deemed this a serious adverse event unrelated to the study's activities. No other adverse events occurred.

4 Discussion

We developed a randomized trial protocol to compare the D-HOMES intervention to Enhanced Usual Care (EUC). D-HOMES is a behavioral program tailored to the unique needs people living with type 2 diabetes who had experienced homelessness (DH) developed via an incremental, community engaged behavioral trial development process. We found D-HOMES and our trial protocol feasible and acceptable to DH with both current or recent homelessness. We found that reaching out to patients already engaged in care at medical clinics best supported recruitment. High staff turnover and open positions in housing and homeless-focused health care settings due to the COVID-19 pandemic limited referrals from these locations and challenged our recruitment. This led us to close enrollment before reaching our initial planned target (n=54) and may limit the generalizability of our pilot trial results. We attribute our overall high retention to the careful creation of a protocol with input from the Quorum team that incentivized participants to remain in contact with the study team each month. We found $20/month to be an appropriate and effective telephone stipend that our target population found meaningful.

TABLE 2 Medical and psychological outcome differences over time between D-HOMES and enhanced usual care.

	Baseline, mean (SD)		3-months, mean (SD)		Change baseline to 3-months	6-months, mean (SD)		Change baseline to 6-months
	EUC	D-HOMES	EUC	D-HOMES	DH vs. EUC (95% CI), *d*, p-value	EUC	D-HOMES	DH vs. EUC. (95% CI), *d*, p-value
Primary clinical outcome								
HbA1c (%)	10.4 (2.2)	10.3 (2.1)	9.6 (2.4)	9.7 (2.3)	0.1 (-1.3, 1.5), *d*=0.05, p=0.861	9.6 (2.4)	9.7 (2.7)	0.1 (-1.3, 1.6), *d*=0.05, p=0.873
Primary behavioral outcome (medication adherence)								
Diabetes medication adherence (ARMS-D)	17.2 (3.9)	15.6 (4.6)	16.7 (3.4)	16.0 (5.2)	0.9 (-1.2, 3.1), *d*=0.26, p=0.400	16.1 (3.7)	15.2 (5.2)	0.6 (-1.6, 2.8), *d*=0.24, p=0.583
Diabetes self-management (DSMQ), Glucose scale	6.6 (3.0)	6.7 (2.5)	6.9 (2.2)	8.1 (2.4)	1.0 (-0.3, 2.4), *d*=0.45, p=0.148	7.1 (2.7)	8.3 (2.2)	1.0 (-0.4, 2.4), *d*=0.43, p=0.179
All medication adherence (ASK-12)	32.9 (7.7)	36.3 (8.5)	35.2 (5.6)	36.9 (6.6)	-1.6 (-6.4, 3.2), *d*=-0.20, p=0.521	32.1 (8.5)	36.4 (6.2)	1.0 (-4.0, 5.9), *d*=0.12, p=0.709
Drug/alcohol use impacting medication adherence (% yes)	22.2	16.7	16.7	5.6	-5.6 (-32.9, 21.8), *d*=NA, p=0.696	14.2	11.1	2.5 (-25.3, 30.4), *d*=NA, p=0.865
Secondary outcomes								
Psychological wellness (MHI-5)	39.8 (21.2)	34.4 (24.9)	37.6 (17.3)	38.0 (20.2)	5.8 (-6.9, 18.4), *d*=0.34, p=0.382	36.7 (24.4)	34.7 (20.6)	3.3 (-9.7, 16.2), *d*=0.15, p=0.629
Diabetes distress (PAID-5)	7.6 (7.2)	8.2 (6.5)	8.1 (7.0)	7.2 (5.8)	-1.5 (-4.1, 1.1), *d*=-0.42, p=0.269	6.9 (6.6)	5.8 (5.4)	-1.7 (-4.4, 0.9), *d*=-0.39, p=0.219
DSMQ, overall	4.7 (1.2)	5.1 (1.2)	5.0 (1.0)	5.6 (1.2)	0.2 (-0.5, 1.0), *d*=0.17, p=0.591	5.1 (1.0)	5.2 (1.1)	-0.3 (-1.0, 0.5), *d*=-0.21, p=0.509
DSMQ Diet scale	4.9 (2.5)	5.4 (2.2)	5.0 (2.4)	6.0 (2.2)	0.4 (-1.2, 1.9), *d*=0.17, p=0.642	5.8 (2.1)	5.9 (2.2)	-0.4 (-2.0, 1.1), *d*=-0.18, p=0.583
DSMQ Physical activ. scale	3.6 (2.3)	3.9 (2.9)	3.5 (2.6)	4.0 (2.9)	0.3 (-1.5, 2.2), *d*=0.10, p=0.749	3.1 (1.8)	2.6 (2.5)	-0.8 (-2.7, 1.1), *d*=-0.28, p=0.418
DSMQ Health care use scale	2.0 (2.1)	2.3 (2.2)	2.7 (2.6)	2.1 (1.9)	-0.9 (-2.5, 0.8), *d*=-0.32, p=0.307	1.7 (1.7)	1.4 (1.7)	-0.6 (-2.3, 1.0), *d*=-0.25, p=0.467
BMI	36.8 (12.8)	31.6 (7.0)	34.7 (10.4)	31.4 (7.2)	2.0 (-0.6, 4.6), *d*=0.40, p=0.144	36.4 (11.9)	31.0 (6.6)	-0.2 (-2.8, 2.5), *d*=-0.08, p=0.906
Systolic blood pressure (mmHg)	131.6 (17.1)	138.1 (19.8)	139.0 (23.4)	132.9 (19.0)	-12.7 (-29.3, 4.0), *d*=-0.55, p=0.147	139.1 (23.4)	126.2 (22.0)	-19.5 (-36.5, -2.6), *d*=-0.69, p=0.030**
Diastolic blood pressure (mmHg)	82.3 (10.2)	84.1 (11.9)	89.1 (15.5)	83.4 (9.4)	-7.5 (-18.0, 3.0), *d*=-0.49, p=0.175	86.8 (16.1)	77.5 (8.9)	-11.1 (-21.9, -0.4), *d*=-0.57, p=0.049**

** Change meeting pre-determined significance threshold of p<.05.

Our study adds to emerging models in the literature of innovations and clinical trials to address type 2 diabetes among people experiencing homelessness (6, 59, 60). However, our work is novel in our focus on a high-quality behavioral intervention with a treatment manual, fidelity measurement, and an incremental treatment development approach. We are also novel in our collaboration with a community engaged research team (Quorum) who has guided this work from conceptualization through pilot trial results. The team collaborated on designing a fully powered hybrid trial, currently under review, as a planned next step in our work. We will also consider further adaptions to better serve people staying outside, or in other places not meant for human habitation, as we did not reach this segment of the homeless population in our work to date.

In this feasibility-focused pilot trial, we were underpowered to detect between group differences in our primary clinical outcome of glycemic control (HbA1c). While we found no between group effect, we were encouraged to find a clinically significant (≥0.5%) improvement in glycemic control in both groups. This may reflect the impact among EUC participants of even one-time brief education and resource support as well as regular contact with our study staff and receipt of $20/month. We continue make improvements to the D-HOMES manual to intensify the

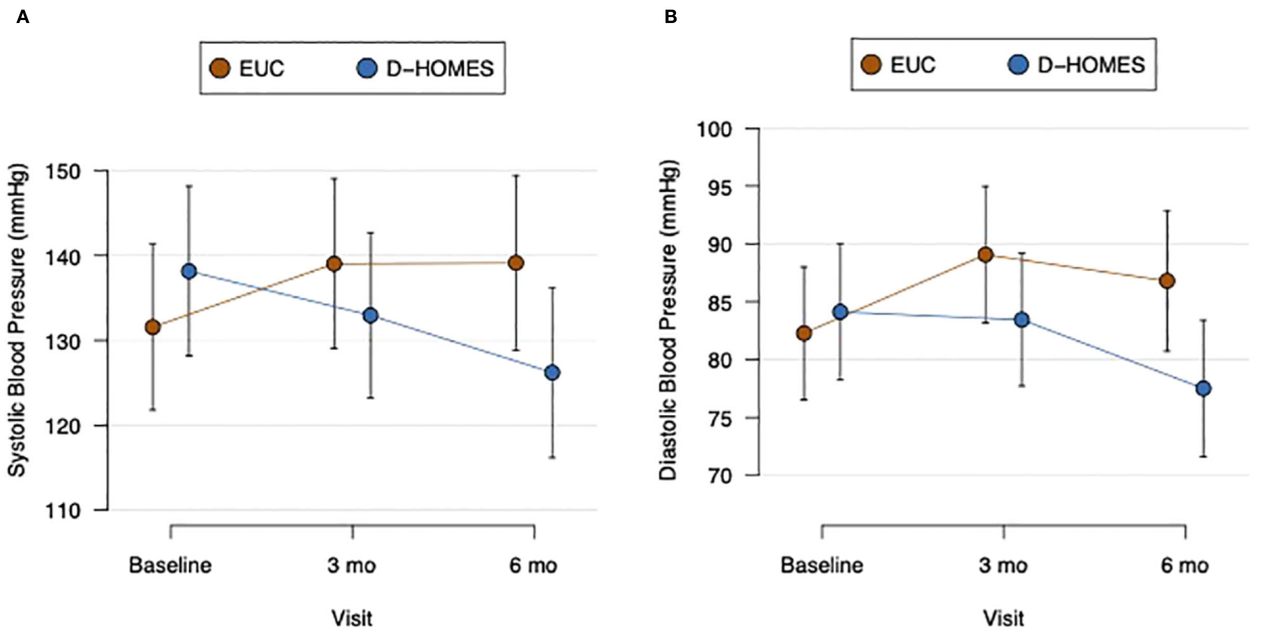

FIGURE 3
Change in systolic **(A)** and diastolic **(B)** blood pressure in D-HOMES and enhanced usual care.

treatment and maximize efficacy. For example, we are presently developing augmented educational content for D-HOMES enrollees with input from the Quorum team. We also plan to add an offer of continuous glucose monitoring to all D-HOMES participants during the initial coaching session to enhance the self-monitoring activity (61). We are also planning to add a longer, in-person second coaching session to review medications and diabetes supplies in participants' homes or natural environments (subsidized apartments, vehicles, shelters, etc.).

While this study was not designed for scale validation, given the dearth of relevant literature, our results can help inform future choices regarding measurement of self-reported diabetes medication adherence among DH. The ARMS-D scale showed substantial ceiling effects and did not improve over time as would be expected given the observed improvement in HbA1c over time. This deviates from observed patterns in other adults with type 2 diabetes (47). The glucose subscale of the DSMQ showed a better distribution and did improve concurrently with HbA1c over time as has been seen in other studies of adults with diabetes (62).

Our challenges using self-report adherence measures parallel struggles other researchers have encountered but may have unique implications in the DH population (63). Participants may have specifically struggled to summarize their adherence to diabetes regimens combining oral and injectable medications and glucose monitoring schedules. They may also have been unaware of their fully prescribed regimen especially at baseline. Specific barriers to accurate self-report may also arise from the complex lives of DH participants who face many competing demands for their time and attention. Participants shared numerous psychosocial stressors with the study team including frequently lost phones, medications, and other belongings; frequent relocation; and being impacted by violence towards their friends and family members. These findings reinforce our plans to focus on glycemic control (HbA1c) as the primary outcome of a larger, fully powered trial.

Psychological wellness (MHI-5) demonstrated scores that indicate majority of participants would meet one suggested diagnostic cut point for mental illness (<76) at all study time points (64). This, along with self-reported comorbidity diagnoses and substance use (Table 1), confirm that our study population aligns with other profiles in the literature of adults who experience homelessness (9, 11). The overlap of race/ethnicity, multiple comorbidities, and social inequities imposed by ongoing structural racism and discrimination within housing and health care systems align with the intersectionality literature which highlights the "multiple burdens" facing some populations that perpetuate social inequality (65, 66). They also connect directly to constructs of structural vulnerability, or the pathways of power relationships that exacerbate health problems. Structural vulnerabilities have been connected to the need for multi-disciplinary health and social services (67). With the continued refinement of D-HOMES, we look forward to continued study of how a behavioral treatment can target such complex needs and how psychological wellness can best be measured in such a context.

We observed a clinically meaningful and sustained reduction in both systolic and diastolic blood pressure among D-HOMES participants at 6-months. This is particularly important because the mean blood pressure among D-HOMES participants at the 6-month point met current guidelines recommended by the American Diabetes Association (<130/80) (68). Guidelines focus on the strong evidence connecting hypertension as a risk factor for development of atherosclerotic cardiovascular disease, heart failure, and microvascular diabetes complications for people living with diabetes (69).

Overall, we conclude that it is possible to recruit and retain people living with diabetes who have experienced homelessness when community engaged research approaches are used to align study protocols to the needs of participants (e.g., providing monthly phone payments). D-HOMES warrants testing in a fully powered trial. With such testing D-HOMES could inform future efforts to use high quality behavioral trials to promote health equity for people facing the severe social risk of homelessness.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: This trial is under review at clincialtrials.gov, NCT05258630.

Ethics statement

The studies involving humans were approved by Hennepin Healthcare Research Institute. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

KV: Conceptualization, Funding acquisition, Investigation, Supervision, Writing – original draft, Writing – review & editing. LG: Conceptualization, Funding acquisition, Investigation, Supervision, Writing – review & editing. AH: Conceptualization, Investigation, Project administration, Supervision, Writing – review & editing. ES: Data curation, Investigation, Project administration, Writing – review & editing. JiC: Investigation, Methodology, Writing – review & editing. OO: Investigation, Methodology, Writing – review & editing. MF: Project administration, Resources, Writing – review & editing. SK: Data curation, Investigation, Project administration, Writing – review & editing. SG: Conceptualization, Resources, Writing – review & editing. EA: Conceptualization, Resources, Writing – review & editing. AA: Conceptualization, Resources, Writing – review & editing. LB: Investigation, Resources, Writing – review & editing. AB: Investigation, Resources, Writing – review & editing. TR: Investigation, Resources, Writing – review & editing. JoC: Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing. ME: Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – review & editing. KE: Methodology, Supervision, Writing – review & editing. WC: Methodology, Supervision, Writing – review & editing. AB: Conceptualization, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Author disclaimer

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Alcohol-associated liver disease and behavioral and medical cofactors: unmet needs and opportunities

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Chronic liver disease is a leading cause of death in the US and is often preventable. Rising burden, cost, and fatality due to liver disease are driven by intensified alcohol use in the US population and the contributions of comorbid conditions. This mini-review focuses on the topic of liver health in the context of chronic, behavioral cofactors of disease, using research-based examples from the Brown University Center for Addiction and Disease Risk Exacerbation (CADRE). Our aim is to illustrate the current challenges and opportunities in clinical research addressing liver health in the context of behavioral and medical comorbidity and to highlight next steps in this crucial area of public health research and clinical care.

KEYWORDS

liver health, integrated behavioral healthcare, alcohol-associated liver disease, chronic liver disease, alcohol use, HIV infection

1 Introduction

Liver health is an unmet medical need globally (1, 2). Chronic liver disease is a leading cause of death in the US and worldwide and is often preventable (3–5). Alcohol-associated liver disease (ALD) is the most prevalent chronic liver disease worldwide and the leading cause for liver transplantation in the US (6). ALD is a health sequela of chronic excessive alcohol use that progresses from hepatic steatosis to alcoholic steatohepatitis and, ultimately, to fibrosis, cirrhosis, and/or hepatocellular cancer. Only a relatively small proportion of individuals progress to the final stage, with advancement influenced by biological sex, ethnicity, smoking status, obesity, and other factors (7). Early stages of liver disease may be "silent" or asymptomatic, and the disease often presents late with fatal complications (8, 9).

The mortality rate for ALD has risen in recent years, with no new treatments introduced in decades (4). ALD affects 1 in 20 US adults, and ALD-related mortality has risen sharply since 2020 (10, 11). Each year, more people are dying of ALD and at younger ages. Deaths due to alcoholic cirrhosis increased more than threefold from 1999 to 2019 (12). The increase in mortality due to alcoholic cirrhosis from 2009 to 2016 was driven by a 10.5% rise in deaths among ages 24–35 (13). Biological females and individuals of Hispanic or Latine ethnic background are disproportionately affected at lower levels of alcohol consumption (7).

At-risk individuals who eventually die of ALD have multiple interactions with medical care providers and hospitalizations in the years preceding their death, each one representing a missed opportunity for detection and intervention (14). Expert recommendations to interrupt the course of liver disease progression include: (1) strengthening detection of early liver disease in primary care to interrupt its course; (2) improving resources for community screening of at-risk individuals; (3) promoting healthy lifestyles to reduce alcohol consumption through government restrictions on alcohol sales (15). Without multidisciplinary research and intervention design, however, the problem of silently advancing chronic liver disease will remain unchecked.

The goal of the Brown University Center for Addiction and Disease Risk Exacerbation (CADRE), a National Institute of General Medical Sciences Center of Biomedical Research Excellence (P20GM130414; PI: Monti), is to examine biobehavioral mechanisms by which substance use increases risk for, and progression of, chronic disease (16). The CADRE is a thematically linked, state-of-the-art, multidisciplinary center utilizing a range of research methods, including experimental laboratory, ecological momentary assessment, health services, and computational modeling approaches. Up to half of all early deaths in the U.S. are preventable, and the leading behavioral correlates of chronic health conditions include tobacco use, unhealthy dietary patterns, alcohol intake, physical inactivity, and sex risk behaviors. These individual determinants account for approximately twice the variance in population health outcomes as direct clinical care (17). In particular, the intersection of these preventable disease cofactors compounds downstream health risks, yet linkages of substance use to chronic disease are complex and often unclear.

Thus, the CADRE thematically investigates interlocking processes by which substance use and chronic health conditions interact to increase risk of morbidity and mortality. The CADRE's mission is realized through synergistic, innovative investigative teams with complementary expertise. CADRE investigators and affiliated scientists are united from behavioral and social sciences, psychiatry and human behavior, medicine, infectious disease, pathology and laboratory medicine, behavioral medicine, and neuroscience. Exemplar current and completed projects in the CADRE's thematic scope include exploration of cannabis effects on pain and inflammatory biomarkers among patients with rheumatoid arthritis (subproject 5264; Project Leader: Aston), syndemic effects of tobacco smoking and alcohol use on cardiovascular disease in incarcerated individuals (Project Leader: Khanna), utilization of individualized biobehavioral feedback for alcohol use disorder (AUD) to reduce ALD risk and progression (subproject 8644: Project Leader: Treloar Padovano), examination of psychopharmacological effects of oxytocin on stress-induced craving and the endogenous opioid system (P20GM130414; Project Leader: Haass-Koffler), and an experimental study of neural and immune effects of acute alcohol in people living with HIV (subproject 5261; Project Leader: Monnig). This mini-review focuses on the topic of liver health in the context of behavioral cofactors, using CADRE research projects as specific examples where applicable. Our aim is to illustrate the current challenges and opportunities in clinical research and care addressing liver health in the context of behavioral and medical comorbidity and to highlight next steps in this important line of work.

2 Clinical research examples on ALD and liver disease cofactors

2.1 ALD and alcohol use disorder (AUD)

Alcohol abstinence remains the best-known treatment for ALD. Helping individuals reduce drinking prior to developing advanced disease and shaping public policy to reduce drinking at a population level are the only preventative interventions available. Many ALD patients struggle to achieve alcohol abstinence due to concurrent AUD, which is itself a chronic condition characterized by alcohol craving and relapse (18–20). AUD rates are disproportionately rising among those at greater risk for ALD mortality. Cofactors modifying ALD progression include genetic, environmental, and behavioral risks, including biological sex, ethnicity, AUD severity, obesity-promoting behaviors, and smoking. Biological females have higher metabolic sensitivity to alcohol and develop ALD at lower alcohol-consumption rates and progress more quickly to end-stage liver disease than biological males (7). Available comparative epidemiologic data suggest that Hispanic or Latine ethnicity is linked to higher rates of hepatic steatosis and accelerated disease progression in both ALD and nonalcoholic steatosis (21, 22). Ethnic differences in disease susceptibility may be related to higher obesity prevalence in Hispanic and Latine communities (23). However, females and persons with minoritized racial and ethnic identities have been drastically underrepresented in clinical studies of ALD.

One of CADRE's major research projects sought to identify overlapping biobehavioral pathways in ALD and AUD. While numerous studies demonstrate effectiveness of behavioral interventions for AUD, surprisingly few clinical trials have tested their efficacy in ALD patients, and the rigor of extant studies is limited by primarily male, nondiverse samples (24, 25). We partnered addiction scientists and hepatologists to test the efficacy of a brief motivational interviewing, alcohol-focused intervention among ALD patients with AUD and a comparative sample of individuals with AUD who had not progressed to advanced ALD, per blood diagnostic biomarkers.

A main behavioral outcome was alcohol craving, a validated predictor of treatment response in AUD clinical trials. A gold-standard laboratory alcohol cue reactivity paradigm (26) was paired with ecologically valid assessments of alcohol cues and craving in daily life. Visual graphs of the in-daily-life craving assessments were combined with personalized liver health feedback as part of the brief motivational intervention. Aligning with the CADRE theme, this research aimed to explore biomarkers of inflammation and immune activation as mechanisms of persistent drinking in AUD and ALD. Specifically, the study sought to explore associations of systemic biomarkers of inflammation with laboratory and real-world alcohol craving, toward the ultimate goal of a more holistic understanding of treatment nonresponse.

A primary aim was to demonstrate feasibility of enrolling ALD patients in the brief motivational alcohol intervention from routine clinical care. Common barriers to recruiting ALD patients in the clinical care setting soon became apparent (e.g., high clinic no-show rates, medical comorbidity, and disease severity), illustrating, in part, context for the lack of clinical trials testing behavioral AUD treatments in this population. Institutional structural barriers and lack of integration with local hospital systems also impeded study progress.

We pivoted, and the soon-to-wrap-up study will meet overall recruitment targets through shifting the focus farther upstream in the ALD progression. Recruitment via social media successfully reached a diverse participant population of heavy drinkers with AUD at risk for ALD.

Offering the study in Spanish was essential to recruiting individuals who identified as Hispanic or Latine. Since its inception, our study aimed to achieve equitable representation of biological females and individuals who identify as Hispanic or Latine. All study materials, laboratory procedures, and the intervention manual were implemented in English or Spanish, thereby not excluding monolingual Spanish speakers from the research. Additional research costs incurred by these activities does not outweigh the need or benefit.

2.2 ALD and human immunodeficiency virus (HIV) infection

Another major project of the CADRE investigates the gut-liver-brain axis in people living with HIV infection (PLWH). Liver disease is a leading cause of death in PLWH, accounting for 13–18% of all mortality (27–29). Investigating effects of alcohol on the liver in the context of HIV is key because PLWH show higher levels of advanced liver disease compared to seronegative individuals, even at nonhazardous levels of alcohol consumption (30). Using experimental alcohol administration procedures, this study uses a 2×2 design (i.e., alcohol vs. placebo beverage; HIV seropositive vs. seronegative participants) to examine the effects of an acute, moderate dose alcohol on biomarkers of gut, liver, and brain health.

Outcomes include peripheral biomarkers of gut- and liver-mediated inflammation, as well as magnetic resonance imaging (MRI) measures of cerebral metabolism. For example, the study quantifies alcohol-induced change in soluble cluster of differentiation 163 (sCD163), an acute phase protein that reflects activation of liver macrophages, i.e., Kupffer cells, in response to inflammatory stimuli, such as alcohol or endogenous molecules (31, 32). In heavy drinkers, alcohol consumption shows a positive linear relation with sCD163 (33). In addition, sCD163 performs well as a marker of liver damage in individuals with HIV (34, 35).

This ongoing project is based in Providence, Rhode Island, and recruits PLWH from the largest outpatient provider of HIV care in the state. Despite integration of recruitment efforts into this clinical setting, however, enrollment of PLWH has presented a major challenge to this study. Barriers to enrollment of PLWH into liver-focused research include both structural and study-related issues. Structural issues include access to clinic patients during busy visits and high patient no-show rates. Lack of shared research administration between the academic institution and hospital system is a major barrier that many clinical researchers face in conducting biobehavioral studies. Study-specific barriers include narrow eligibility criteria needed to ensure safety for study procedures, i.e., alcohol administration, blood draw, and MRI. Individual-level issues include unwillingness of patients to be approached for any research purpose; transportation; and scheduling availability around other obligations such as work. Solutions to these problems have been offered to the extent possible, such as provision of paid transportation. In addition, the study has implemented alternative methods of recruiting PLWH, including social media and targeted ads, resulting in an improved rate of enrollment. Our experience suggests that reaching out directly to individuals in the community was more successful than clinic-mediated recruitment for this specific study on alcohol and liver disease in PLWH.

2.3 ALD and obesity

Metabolic dysfunction-associated steatotic liver disease (MASLD) is the most prevalent liver disease globally and affects ~25% of the US (2, 36). Obesity is the most significant risk factor for MASLD, affecting ~80% of persons with obesity (36). Obesity and alcohol use synergistically increase risk of liver damage, leading to cirrhosis, liver cancer, and death from liver disease (37–39). Current consensus is that that any alcohol use can accelerate progression of MASLD (40). Metabolic syndrome and excessive drinking independently increase risk of mortality in individuals with MASLD or ALD (41). Yet biological and behavioral factors mechanisms leading to steatosis (i.e., fatty liver) and fibrosis (i.e., scarring) in individuals with obesity and at-risk drinking is unclear (42, 43).

Despite clear overlap in behavioral precedents and adverse health outcomes, the fields of obesity and substance use research historically had minimal crosstalk or collaboration, and this disjunction is apparent in research on liver-health consequences. Thresholds for "moderate drinking" differ between the American Association for the Study of Liver Disease (40), the National Institute for Alcohol Abuse and Alcoholism (44), and other US and international research groups. Such differences are not trivial and make interdisciplinary research challenging. Clinically, the distinction between ALD and MASLD is made by self-reported alcohol use. As acknowledged by the American Association for the Study of Liver Diseases (40), the alcohol-use threshold used to differentiate ALD and MASLD in clinical practice is arbitrary and, in reality, few patients fit neatly into one category (42). Consequently, prior research treated MASLD and ALD as separate entities, despite shared pathophysiology and the co-prevalence of overweight/obesity and at-risk drinking (42). Notably, expert consensus published in December 2023 designates a new category of chronic steatotic liver disease termed metabolic and alcohol-associated liver disease, abbreviated MetALD (45). This new MetALD diagnostic category reflects the clinical reality that there is a significant proportion of individuals with both overweight/obesity and at-risk alcohol intake as contributors to their chronic liver disease. This newly recognized group is understudied and undertreated. An approach that integrates obesity, hepatology, and alcohol expertise is needed to address this clinical reality while optimizing benefits to patient care and public health.

3 Advancing research on behavioral cofactors and conditions in liver health

Studies to characterize risk for liver disease in individuals as a function of concomitant risk factors such as ALD, HIV, and obesity are critical for development of novel individualized lifestyle and liver-health interventions to reduce risk. Key goals are to identify: (1) the most effective ways to reach individuals with concomitant liver health risk factors and engage them in research and screening; (2) pragmatic, non-invasive approaches to liver screening and their contribution to early identification and behavior change; (3) novel biomarkers that could be used in future trials focusing on these conditions; and (4) factors that contribute to the interplay between alcohol use and lifestyle behaviors that promote risk for liver disease. Elements of special emphasis for public health benefit include: (1) integrating rather than dichotomizing alcohol use and risk cofactors, e.g., HIV or obesity, in liver disease; (2) focusing on representation in liver health research, particularly women and individuals of minoritized racial or ethnic identities; (3) screening early to identify signs of liver damage in specific high-risk populations.

As noted, efforts to recruit individuals to participate in clinical research on liver health often rely on medical record reviews and recruitment from local hepatology, gastroenterology, or other specialty clinics. Limitations of this strategy include the extremely high no-show rates coupled with low interest or ability to participate and comply with research protocols. These barriers are due, in part, to the nature of chronic and complex intersecting behavioral health conditions (e.g., AUD), comorbid health conditions (e.g., HIV infection), and liver impairment. Community-based engagement strategies would improve the ability to meet the target population where they are, toward the goal of engaging the broader population of adults with poor liver health who are not linked with treatment or not engaging with treatment. The goal is to enhance research access for adult populations that: (1) are historically difficult to engage in clinical care and in research studies; (2) experience social determinants of health (e.g., location, resources, education) as key barriers to research participation; (3) are at high risk of liver-related health problems from alcohol use, opioid use, obesity, etc.; and (4) are in high need but low receipt of intervention to reduce risks to liver health.

Ideally, integrated care teams with psychiatrists, psychologists, social workers, and hepatologists would see patients in the same clinical setting (46). Simply having one appointment in one place would address a range of logistical barriers to care, such as transportation, as well as stigma-related barriers that place the burden of finding AUD treatment on the ALD patient. Ideally, researchers would adopt a team-science approach to draw from strengths of siloed institutions for multisite studies and consider remote digital monitoring and telehealth approaches to reach populations who are too medically compromised to attend study visits.

Approaches to lessen provider, patient, and systemic/administrative barriers include: (1) expanded medical training curriculum using evidence-based models; (2) provider education in brief screening tools and screening, brief intervention, and referral to treatment (SBIRT) models; (3) training in motivational interviewing style, e.g., partnering and empathizing with the patient, and specific techniques to promote lifestyle changes, e.g., selectively reinforcing "change talk" in favor of goal behavior while softening "sustain talk" in favor of unhealthy behavior; (4) applying digital health monitoring and telemedicine approaches to deliver interventions to those who are too ill to attend appointments; (5) involving social work support to address financial and resource barriers.

Detecting disease modifiers is essential to appropriately allocate preventative interventions and apply personalized treatment. Ethnic disparities in chronic liver disease are complex, with likely contributions from genetic and environmental factors, as well as inequities in health-care access and socioeconomic wealth (22). Liver health disparities are likely to intersect with disparities in the treatment cascade for comorbid conditions such HIV infection. As one such example, Black individuals living with HIV have a lower likelihood of initiating antiretroviral therapy and attaining viral suppression (47–49). Comparative epidemiologic studies among specific ethnic groups are sorely needed, and the potential intersection of sex, ethnicity, and lifestyle cofactors in modifying disease risk needs to be explored. Such studies are key to understanding where along the ALD spectrum disparities begin to emerge and which risk determinants differ at each stage.

Chronic liver disease driven by lifestyle factors does not develop overnight. And yet, patients are expected to stop drinking overnight when told by their care provider to do so. Similar frustrations may be experienced by patients with obesity or diabetes who are advised to improve their eating habits or increase their physical activity. Although new biologic prevention and treatment options for ALD are sorely needed, effective behavioral and pharmacological options to treat concurrent AUD are currently available but underutilized. Evidenced-based interventions for AUD, such as screening and brief motivational interviewing or acamprosate treatment, are as effective as many other common medical interventions, such as statins for high blood pressure. However, AUD treatments are understudied and underutilized with ALD patients. Moreover, referral bias, exclusive focus on advanced disease stages in a clinical care setting, non-standardized disease definitions, and accuracy of screening and diagnosis tools are well-documented limitations in research and treatment. There is a high need for training ALD medical providers in AUD screening, diagnosis, and brief motivational approaches.

4 Conclusion

The CADRE's experience conducting biobehavioral research on liver health in the context of chronic diseases, specifically AUD and HIV infection, is just one powerful exemplar of the need for integrated liver healthcare and research. Establishing multidisciplinary care clinics is a critical next step to better understanding and addressing the intertwined pathophysiology of ALD and chronic diseases through a collaborative team of hepatologists, pharmacists, addiction psychologists, and psychiatrists. Models for integrative ALD care clinics have been proposed, and real-life examples include the Delivery of Early Liver Transplant for Alcoholic Hepatitis (DELTA) Center for Alcohol Research at Johns Hopkins University and Michigan Alcohol Improvement Network (MAIN) at the University of Michigan (46, 50–52). The overlap of ALD with chronic, behaviorally driven conditions such as obesity, heart disease, and diabetes is an understudied issue of massive and increasing significance in the US population, pressing the need to disseminate effective models for integrated research and care.

Author contributions

MM: Conceptualization, Writing – original draft. HT: Conceptualization, Writing – original draft, Writing – review & editing. PM: Conceptualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Development and validation of a prediction nomogram for depressive symptoms in gout patients

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Objective: The objective of the study was to explore the risk factors for depressive symptoms in patients with gout and to construct and validate a nomogram model.

Methods: From October 2022 to July 2023, a total of 469 gout patients from a Class iii Grade A hospital in Northeast China were selected as the research objects by the convenience sampling method. The General Information Questionnaire, Self-Rating Depression Scale, Gout Knowledge Questionnaire, Self-Efficacy Scale for Managing Chronic Disease (SEMCD), and Social Support Rating Scale were used to conduct the survey. Univariate and multivariate logistic regression analyses were used to establish a depression risk prediction model and construct a nomogram. The bootstrap method was used to verify the performance of the model.

Results: The detection rate of depressive symptoms in gout patients was 25.16%. Binary logistic regression analysis showed that male, the number of tophi, acute attack period, lack of knowledge about gout, the number of attacks in the past year, and the duration of the last attack were independent risk factors for post-gout depression. Female, interictal period, chronic arthritis period, knowledge of gout, and social support were protective factors for post-gout depression ($p < 0.05$). The calibration ($\chi^2 = 11.348$, $p = 0.183$, $p > 0.05$) and discrimination (AUC = 0.858, 95%CI: 0.818–0.897) of the nomogram model for depressive symptoms in gout patients were good.

Conclusion: The prevalence of depressive symptoms in gout patients is high, and it is affected by gender, current disease stage, number of tophi, gout knowledge level, the number of attacks in the past year, and the last attack days. The nomogram model is scientific and practical for predicting the occurrence of depressive symptoms in gout patients.

KEYWORDS
immunotherapy, gout, depression, nomogram, prediction model

1 Introduction

Gout is a chronic ailment triggered by a disruption in the body's purine metabolism (1). This metabolic imbalance leads to an accumulation of monosodium uric acid crystals, either in joints or non-joint areas, subsequently inducing joint inflammation or causing damage to surrounding tissues. Its clinical manifestations are diverse, including hyperuricemia, acute gouty arthritis, tophus formation, gouty nephropathy, joint deformity, and dysfunction, among others (2). This condition has systemic effects, often impacting multiple organs and potentially causing widespread damage. When gout flares up, patients typically experience acute and intense pain in their peripheral joints, accompanied by redness, heat, and lasting discomfort that can persist for hours. As the condition progresses, the deposition of monosodium uric acid crystals increases, elevating the likelihood and severity of tophus occurrence. This can lead to joint damage, deformation, and even disability, significantly affecting the patient's mobility and overall quality of life (3).

In recent years, alterations in lifestyle have contributed to a yearly increase in gout cases in China, with a noticeable trend toward younger patients (4). Gout, currently considered the second most prevalent metabolic disease after diabetes, poses a significant threat to individuals' physical and mental wellbeing. Economic growth, changes in dietary habits, and evolving lifestyles have led to a gradual global increase in gout prevalence. Currently, gout rates vary from 0.1 to 6.8% across different countries, with a reported prevalence of 1.1% in China (5). Recent statistics reveal that the number of individuals with high uric acid hematologic disorders in our country has escalated to 170 million, with over 14.66 million gout patients (6). Studies indicate that gout affects more men than women and is showing a trend toward younger age groups, with the disease burden also on the rise (7, 8).

Research has revealed that gout has a recurrence rate of up to 63% (9). Repeated flare-ups and the excruciating pain they bring significantly impact patients' quality of life and healthcare consumption. These flare-ups can cause considerable mental health deterioration, leading to anxiety, depression, or other psychological issues (10). Consequently, this can result in decreased compliance with gout treatments (11). Early identification and targeted interventions can alleviate the psychological stress on gout patients, thereby enhancing their adherence to treatment and improving their overall quality of life (12). However, current research on depression among gout patients remains limited to status surveys, and there is a lack of a reliable tool to identify depressive symptoms specifically tailored for this patient population. Therefore, this study aimed to explore the factors associated with depressive symptoms in gout patients and develop a risk prediction model based on a nomogram. This model will provide valuable evidence for the early identification and prevention of depressive symptoms in gout patients.

2 Materials and methods

2.1 Study population

Using the convenient sampling method, gout patients who were treated in the Department of Rheumatology and Immunology of a Class iii Grade A hospital in Shenyang, Liaoning Province, from November 2022 to July 2023 were selected as the research objects. The inclusion criteria were as follows: ① meeting the diagnostic criteria of the 2015 American College of Rheumatology (ACR) guidelines (13); ② age ≥ 18 years old and disease duration ≥1 year; ③ communicating normally and cooperating to complete the questionnaire; and ④ willing to participate in the study and sign the informed consent form. The exclusion criteria were as follows: ① previous psychiatric history or history of cognitive and mental disorders and ② patients had a definite diagnosis of depression before gout diagnosis. This study was approved by the medical ethics committee of the hospital where the study was conducted.

2.2 Data collection

The following survey instruments for data collection were used: ① General Information Questionnaire: The questionnaire was self-designed by the research team based on the results of our previous research and a literature search, which included socio-demographic factors such as gender, age, body mass index (BMI), education level, marital status, occupation, medical insurance, family *per capita* monthly income, and residence. Family history, course of disease, number of tophi, cumulative number of joints, current disease stage, number of attacks in the past year, duration of the last attack, number of chronic diseases, and other disease-related data. ② Self-rating Depression Scale (SDS) was used to evaluate the depression of gout patients. The scale contained 20 items; each item was scored on a Likert four-point scale, ranging from "no or little time" to "most or all time" (14). The original crude score was multiplied by 1.25 to calculate the standard score. When the total score of the standard score is ≥53, the patient has depression. ③ Gout Knowledge Questionnaire (GKQ) consisted of 10 questions (15). Each item was correctly answered with one point, the total score was 0–10, and a score ≥ 7 was considered to be gout-related knowledge. The Flesch–Kincaid readability score of the questionnaire was 4.7, and the Flesch readability was 81.4%. ④ Self-Efficacy Scale for Managing Chronic Disease (SEMCD) (16): The scale was designed by Lorig et al. from Stanford University in the study of self-management behavior of patients with chronic diseases. It contained a total of 6 items, which reflected the self-efficacy of patients with chronic diseases in many aspects, including symptom management, role function, emotional control, and communication with doctors. Each item was scored from 1 to 10, with 1 indicating no confidence and 10 indicating complete confidence. The average score of the six items reflected the level of self-efficacy, and the higher the score, the higher the self-efficacy. The scale is easy to use and has been widely used. Cronbach's α coefficient was 0.87, and the test–retest reliability was 0.91. ⑤ Social Support Rating Scale (SSRS): The revised version of the social support scale developed by Xiao Shuiyuan in 1990 was adopted, including three dimensions and 10 items (17). The three dimensions were: objective support (the actual support received by patients), subjective support (the emotional support or support that can be experienced by patients), and social support utilization (the active utilization of various social supports by patients). In the Social Support Rating Scale, the correlation coefficient between the three subscales and the total scale ranged from 0.724 to 0.835, and Cronbach's α coefficient was 0.780.

2.3 Statistical analysis

SPSS26.0 was used for statistical analysis, including the chi-square test, independent sample *t*-test, and logistic regression analysis. Statistical significance was set at $p < 0.05$. All statistical tests were two-tailed. RStudio software was used to construct the risk prediction model. Nomogram was used for model visualization. The discrimination ability of the nomogram was measured using the Harrell concordance index (C-index). The receiver operating characteristic (ROC) curve was used to evaluate the diagnostic efficacy of the model. Consistency between actual and nomogram-predicted generalization probabilities was assessed using calibration curves (1,000 resampling bootstraps) in the internal verification.

3 Results

3.1 Univariate analysis of depressive symptoms in gout patients

A total of 469 gout patients were included in the care; 118 cases (25.16%) had depression, whereas 351 cases (74.84%) did not have depression. There were statistically significant differences in the incidence of depressive symptoms in gout patients with different genders, marital status, number of tophus, disease stage, level of gout-related knowledge, number of attacks in the past year, duration of the last attack, number of chronic diseases, pain degree, number of joints involved, self-efficacy, and social support ($p < 0.05$). There was no significant difference in the incidence of depressive symptoms among gout patients with different ages, body mass index, education levels, family monthly income *per capita*, working status, medical insurance status, permanent residence, family history, and family support ($p > 0.05$), as shown in Table 1.

3.2 Binary logistic regression analysis of depressive symptoms in gout patients

Taking gout patients with depressive symptoms as the dependent variable (assignment: 0 = no, 1 = yes) and the statistically significant factors in the univariate analysis as the independent variables (assignment of independent variables is shown in Table 2), binary logistic regression analysis was performed, $\alpha_{in} = 0.05$, $\alpha_{out} = 0.10$. Regression analysis showed that male, the number of tophi, acute attack period, lack of knowledge about gout, the number of attacks in the past year, and the duration of the last attack were independent risk factors for post-gout depression. Female, intermittent period, chronic arthritis period, gout knowledge, and social support were the protective factors for post-gout depression ($p < 0.05$) (Table 3).

3.3 Construction of a risk prediction model for depressive symptoms in gout patients

Based on the independent factors entered into the regression model (gender of gout patients, number of tophi stones, current disease stage, number of attacks in the past year, duration of the last attack, gout knowledge level, and social support), a risk prediction model for depression in caring for gout patients was constructed, and a nomogram was constructed, as shown in Figure 1. As shown in the first line of the "points" as a standard score, with the "gender" to illustrate, when evaluating patients with sex for women, the corresponding score is about 31.5; in this way, it is concluded that the patient with the score of seven variables, in the "total points" found on the location of the total score, should draw a line straight down. The number at the intersection of this line and "risk" is the risk probability of depression in this gout patient. The high coincidence degree between the line of data points and the diagonal oblique line indicated that the prediction model had a good calibration, as shown in Figure 2. The area under the ROC curve (AUC) was 0.858 (95% CI, 0.818–0.897), indicating that the model had good discrimination, as shown in Figure 3. The red curve drawn by the prediction model, which is higher than the two extreme lines, indicates that the clinical practical value of the prediction model is good and patients can benefit from it, as shown in Figure 4. The bootstrap method was used for internal validation of the model, and the area under the ROC curve (AUC) was 0.860 (0.857–0.862), indicating that the model had good discrimination. The Hosmer–Lemeshow test results showed that $\chi^2 = 11.348$, $p = 0.183$ ($p > 0.05$), suggesting that the prediction model had good consistency.

4 Discussion

The psychological status of patients with gout is poor due to the characteristics of prolonged gout, repeated attacks, and severe pain during attacks. A meta-analysis showed that gout is positively correlated with depression (18). The results of this study showed that the detection rate of depressive symptoms in gout patients was 25.16%, which was similar to the results of Ding Yayi's study (19) and lower than the results of Chen Qiuzhi's study (20). On the one hand, gout patients have severe pain due to repeated attacks of the disease, which can lead to joint deformation or tophus in severe cases, seriously affecting the body image. On the other hand, it is necessary to control the intake of purine for many years to manage the disease, which puts forward more stringent requirements for the management of the daily life of gout patients, leading to depressive symptoms. Therefore, attention should be paid to the psychological status of gout patients during health education or nursing intervention, and psychological AIDS should be used to intervene in time for patients with depression tendency.

4.1 Analysis of influencing factors of depressive symptoms in gout patients

The results showed that female, the number of tophi, acute attack period, the number of attacks in the past year, the duration of the last attack, and the lack of knowledge about gout were independent risk factors for post-gout depression. Male, intermittent period, chronic arthritis period, awareness of gout knowledge, and social support are protective factors for post-gout depression. The results of this study showed that the incidence of depressive symptoms in female patients with gout was 4.048 times that in male patients, which was consistent with the results of Chen's study (20). Women are more likely to have anxiety or depression symptoms than men, possibly due to personality

TABLE 1 Comparison of the incidence of depressive symptoms in gout patients with different characteristics.

	Number of cases	Non-depressed ($n = 351$)	Depressed ($n = 118$)	X^2	p
Gender					
Male	400	314	86	19.341	< 0.001
Female	69	37	32		
Age				4.402	0.111
18–43	262	205	57		
44–59	95	59	36		
60~	51	26	25		
Body mass index (BMI)				0.682	0.878
Too low	21	16	5		
Normal	288	218	70		
Overweight	113	84	29		
Obesity	47	33	14		
Marital status				7.871	0.049
Unmarried	91	69	22		
Married	350	267	83		
Divorce	15	9	6		
Widowed	13	6	7		
Level of education				3.667	0.300
Junior high school and below	127	103	24		
High school or technical secondary school	114	82	32		
Undergraduate or junior college	146	106	40		
Graduate student and above	82	60	22		
Household *per capita* monthly income				3.301	0.347
<3,000	62	46	16		
3,000~	146	108	38		
5,000 ~	146	104	42		
>7,500	115	93	22		
Working status				0.962	0.327
Unemployed	177	128	49		
Employed	292	223	69		
Medical insurance				0.017	0.895
Have not	58	43	15		
Have	411	308	103		
Residence				0.117	0.732
Rural areas	141	107	34		
Cities	328	244	84		
Family history				0.527	0.468
Have	104	75	29		
Have not	365	276	89		
Numbers of tophus				56.399	< 0.001
No tophus	286	248	38		
Single tophi	131	77	54		

(Continued)

TABLE 1 (Continued)

	Number of cases	Non-depressed (n = 351)	Depressed (n = 118)	X^2	p
Multiple tophi	52	26	26		
Disease stages				23.845	< 0.001
Acute attack period	135	83	52		
Interval period	279	231	48		
Chronic arthritis stage	55	37	18		
Knowledge of gout				11.634	0.001
Do not know	327	230	97		
Know	142	121	21		
Number of attacks in the last year	469	2.93 ± 3.013	4.70 ± 2.655	5.687	< 0.001
Duration days	469	4.40 ± 2.733	5.69 ± 2.846	4.362	< 0.001
Number of comorbidities	469	0.80 ± 0.931	1.07 ± 1.002	2.617	0.009
Level of pain	469	6.07 ± 1.827	6.69 ± 2.032	2.97	0.003
The number of joints involved	469	2.26 ± 1.817	3.60 ± 2.173	6.026	< 0.001
Self-efficacy	469	6.75 ± 2.112	5.32 ± 1.982	6.424	< 0.001
Social support	469	36.57 ± 7.886	31.10 ± 7.753	6.547	< 0.001

TABLE 2 Assignment of independent variables.

Independent variables	Assignment of value
Gender	Male = 1, Female = 2
Marital status	Unmarried = 1, Married = 2, Divorced = 3, Widowed = 4
Number of tophi	No tophi = 1, Single tophi = 2, Multiple tophi = 3
The present stage of the disease	Acute attack period = 1, Interval period = 2, Chronic arthritis stage = 3
Knowledge of gout	Do not know = 1, Know = 2
Number of attacks in the last year	Measured values
Days of duration	Measured value
Number of comorbidities	Measured values
Level of pain	Measured value
Number of joints involved	Measured values
Self-efficacy	Measured values
Social support	Measured values

characteristics and hormone secretion. Hormone fluctuations may play a role in the increased risk of depression in women, especially during the menopausal transition period (21). The severity of gout can be reflected by the number of tophi, the current disease stage, the number of attacks in the past year, and the duration of the last attack. This study shows that patients with multiple tophi have a higher risk of depressive symptoms than those with a single tophi or those without tophi, and studies have shown that the number and dysfunction of tophi are the main contributors to depression in gout patients (22). Compared to the gout interictal stage and chronic arthritis stage, patients in the acute attack stage of ventilation have higher depressive symptoms, which may be closely related to the severe joint pain caused by a gout attack.

This study also showed that the higher the number of gout attacks in a year and the duration of gout attacks, the higher the risk of depressive symptoms in gout patients, which was consistent with Fu's study (12). Recurrent acute attacks of gout not only bring physical pain to patients but also affect their normal life, work, and social function. It will have a negative impact on patients from both physical and psychological aspects and seriously damage their quality of life (22).

Related studies have shown that a higher level of social support has a strong positive effect on the mental health of gout patients (23), which is consistent with the results of this study. Social support can be various forms of recognition, support, and help provided by family, friends, neighbors, colleagues, etc. (24). When social support plays a positive role, it will have a positive effect on the physical and mental health of gout patients. Gout patients with a higher level of social support can invest more energy in self-management and psychological regulation and have more confidence to deal with various challenges in the process of disease management so that they can face the disease more actively with a high level of self-management efficacy and thus reduce the occurrence of depression and other negative emotions due to disease recurrence. Therefore, when managing gout patients, medical staff should also provide relevant training for their family members, use effective intervention methods to provide long-term psychological counseling for gout patients with depression tendencies, eliminate their subjective bad feelings, and relieve their physical and mental pressure.

Nomogram, a plane graph with graduated line segments based on regression results, is used to assess the scientific and practical validity of the depression risk prediction model for gout patients. Its essence is the visualization of regression equations (25). In this study, seven variables entered into the regression equation model were integrated to construct a nomogram model. The results showed that the nomogram had good discrimination and calibration [AUC = 0.860 (0.857–0.862)], and the H-L deviation

TABLE 3 Binary logistic regression analysis of depressive symptoms in gout patients.

Variables of interest	B	SE	Wald X^2	OR (95%CI)	p
Constant	1.394	0.999	1.949		
Gender	1.398	0.352	15.772	4.048 (2.03 ~ 8.071)	< 0.001
The number of tophi	0.736	0.206	12.782	2.087 (1.394 ~ 3.123)	< 0.001
Stage of illness (acute attack period)			10.765		0.005
Stage of illness (interval period)	0.939	0.297	10.007	0.391 (0.219 ~ 0.7)	0.002
Stage of illness (chronic arthritis stage)	0.992	0.475	4.362	0.371 (0.146 ~ 0.941)	0.037
Knowledge of gout	0.706	0.322	4.814	0.494 (0.263 ~ 0.927)	0.028
The number of attacks in the past year	0.144	0.049	8.482	1.155 (1.048 ~ 1.272)	0.004
The number of days the most recent episode lasted	0.159	0.045	12.375	1.173 (1.073 ~ 1.281)	< 0.001
Social support	0.087	0.019	20.171	0.917 (0.883 ~ 0.952)	< 0.001

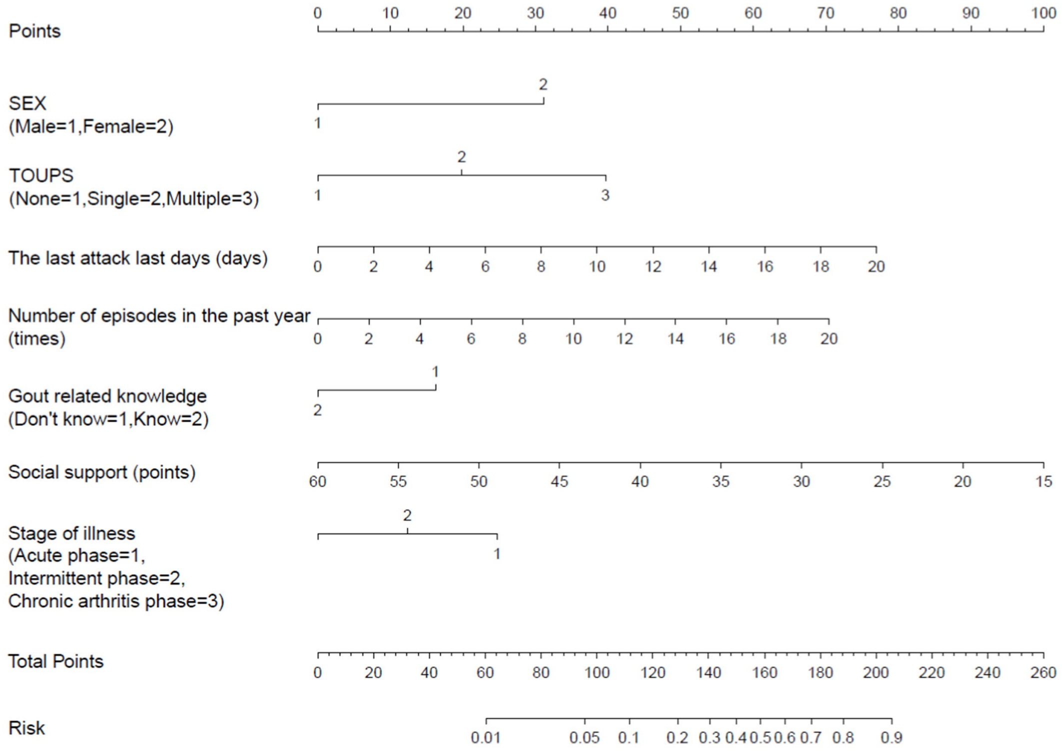

FIGURE 1
Gout patients with depressive symptoms nomogram of the risk prediction model.

test results showed that $\chi^2 = 11.348$, $p = 0.183$ ($p > 0.05$). Based on the nomogram, the individual measured variable values were perpendicular to the first line to find the corresponding points. After adding the corresponding scores of each variable value, a point was found at the total points. The risk of depressive symptoms in gout patients was found to be perpendicular to the last line. The nomogram-based risk prediction model for depression in gout patients is scientific and practical and can provide personalized and high-accuracy risk estimation for post-gout depression in gout patients. At the same time, because the risk factors are visualized by the nomogram model, medical staff can estimate the risk of depressive symptoms in gout patients according to the model so as to find the tendency for depression early and then carry out effective interventions to prevent the occurrence of depression.

5 Limitations

The present study has several limitations. First, the AUC is larger for the validation cohort than the development cohort. This is probably due to the small sample size and the high variability (as a result of the small

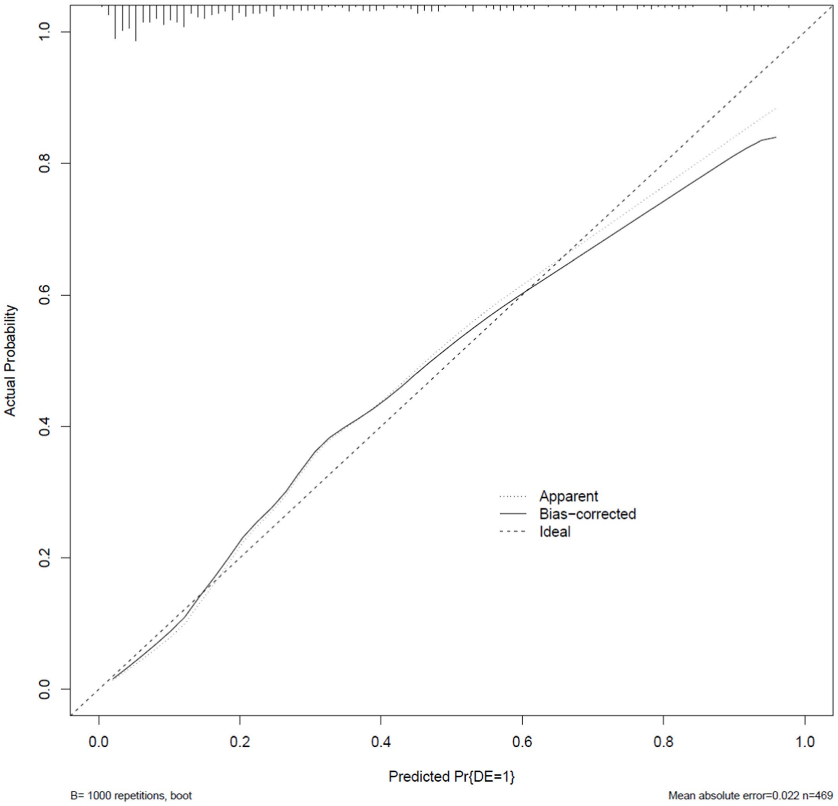

FIGURE 2
Gout patients with depression risk prediction nomogram classification calibration curve of the model.

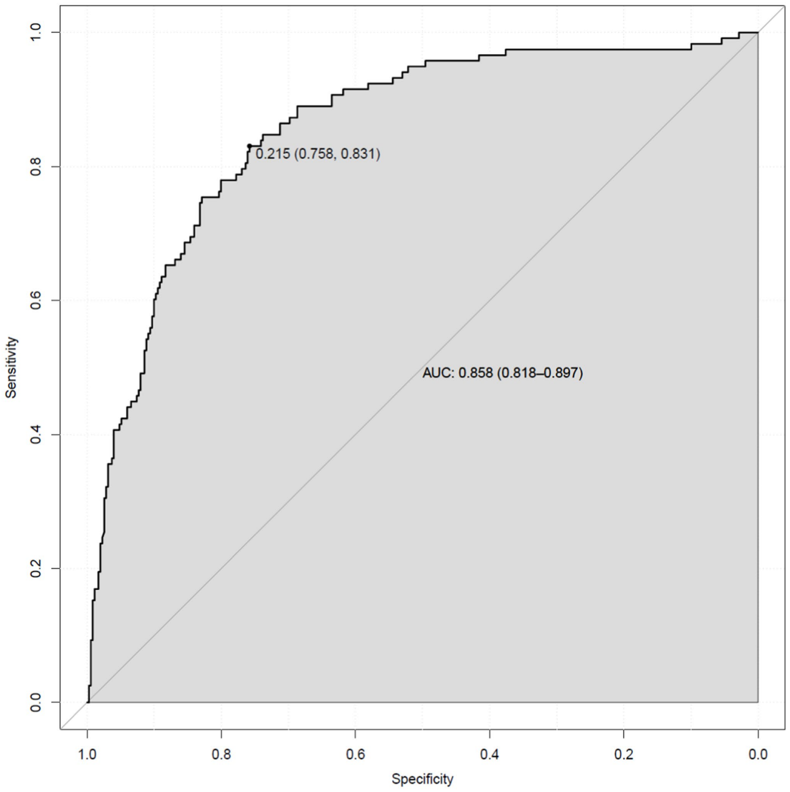

FIGURE 3
Gout patients with depression risk prediction nomogram model of the ROC curve.

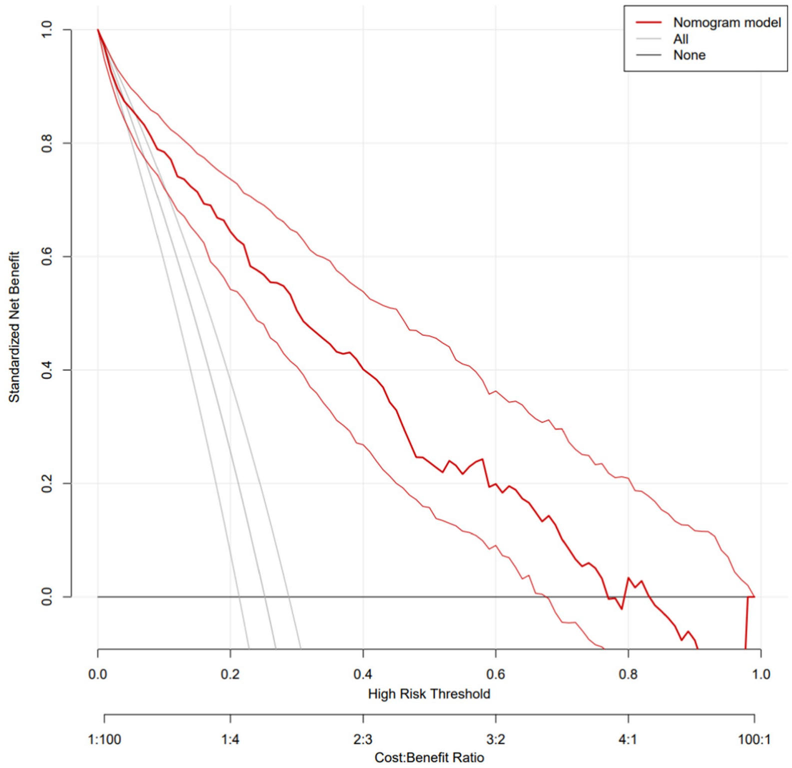

FIGURE 4
Gout patients with depression risk prediction nomogram DCA curves of the model.

sample size in the validation cohort). Meanwhile, this also reflected that the prediction model was not overfitted. Second, the related factors included in the model are limited, and we should consider continuing to include more influencing factors of post-gout depression to further supplement the results (such as the patient's diet and medication, and the amount of vitamin D and uric acid in the blood). Finally, this study only included outpatients with gout in one tertiary hospital in northeast China, so the selection of the sample size was limited. Despite internal validation demonstrating good discrimination and calibration of the nomogram model, we did not perform external validation. Hence, external validation using other ethnic populations and centers with a larger-scale sample size is warranted to further improve the prediction performance of the model.

6 Conclusion

The detection rate of depressive symptoms in gout patients is high. This study has established a risk prediction model for depression in this population, which is conducive to early identification of depression in this population, and the model has good test efficiency.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the First Hospital affiliated to China Medical University Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

XH: Writing – original draft. AW: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Strengthening the delivery of integrated physical health care for adults experiencing serious mental illness: a scoping review of interventions in mental health settings

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Individuals living with serious mental illness (SMI) face significant barriers to accessing appropriate physical health care, poorer associated health outcomes and premature mortality compared to the general population. This scoping review examines service delivery models and clinical practices supporting the integration of physical health care for adults with SMI within mental health settings, and their outcomes. Searches of four academic databases yielded 65 academic articles. Most integrated service delivery models were implemented in community mental health settings in the United States and incorporated elements of Wagner's Chronic Care Model, emphasizing delivery-system redesign, patient self-management support and use of clinical information systems. In most outcome studies, integrated care models were associated with improvements in primary care access and preventative screening rates, while other physical health indicators and emergency and inpatient service use demonstrated promising but mixed results. Implementation challenges of integrated service delivery models included securing financial resources and maintaining effective use of clinical information systems, among others. Successful implementation was facilitated by effective teamwork, care coordination, and administrative and leadership support. Study findings highlight the complexity of integrating physical health care in mental health settings, and the longer timeframes needed to observe changes in some outcomes. The review further underscores the need for ongoing efforts to advance integrated care delivery in mental health settings and the importance of longitudinal data collection to fully assess and optimize the implementation and outcomes of these interventions.

Systematic Review Registration: https://doi.org/10.17605/OSF.IO/3T9VK.

KEYWORDS

serious mental illness, integrated care, reverse integration, premature mortality, service delivery

Introduction

Serious mental illnesses (SMIs), such as schizophrenia, bipolar disorder and treatment resistant depression, are chronic health conditions that severely impact the everyday functioning and quality of life of affected individuals (1–7). Adults with SMI between 18 and 49 years of age are 3.2 and 2.5 times more likely to die from cardiovascular disease (CVD) and stroke respectively, and die on average 10–20 years earlier compared to the general population (8, 9). Although findings on the relationship between SMI and cancer mortality remain mixed, adults with SMI 50–75 years of age were 1.32 more likely to die of respiratory cancer compared to the general population in one study (9), while lower cancer screening rates among adults with SMI are well documented (10). Multiple factors contribute to premature mortality among adults living with SMI, including individual level, health system level, and social and community level factors (11–13). Illness-related and behavior specific factors can hinder individuals' ability to manage their physical health and adhere to treatment regiments (14–18). Additionally, antipsychotic medications commonly used to treat SMI are associated with significant side effects, such as weight gain and metabolic imbalances (19, 20). Furthermore, limited access to comprehensive primary care, poor service design and engagement, and diagnostic overshadowing make screening and timely treatment of common health conditions challenging for this population (3, 21–23). Collectively these barriers result in poor quality and experiences of care and growing health disparities among adults with SMI, further accentuated by poverty, homelessness and social isolation (24–30).

To date, most efforts to integrate physical and mental health service delivery have focused on introducing mental health professionals into primary care settings to address the needs of individuals with mild and moderate mental health conditions (31–34). Generally, these models have demonstrated improved patient outcomes and adaptability to the needs of diverse subpopulations, with implementation costs typically offset by longer term healthcare expenditures (35, 36). Less is known about how best to deliver integrated physical and mental health care within mental health settings, such as psychiatric hospitals and community mental health teams serving adults with SMI, who are less likely to engage in primary care services (33, 37). Recent literature has conceptualized such efforts as "reverse integration", a term referring to providing collaborative physical and mental health care within behavioral rather than primary care settings (38–40).

Various reverse integration models have been described in the international literature in recent years, along with policy development and targeted initiatives in some countries (38, 39, 41–43). Furthermore, research efforts have examined the impact of peer-led self-management, provider education, electronic reminders, and other patient-centered approaches to promote attention to and treatment of chronic health conditions in this population (44–53). Finally, in Canada and other countries, without specific policy or practice mandates, mental health service organizations have been increasingly introducing hospitalist physicians or nurse practitioners to support the physical health needs of adults with SMI in their setting (54–57). Yet despite growing awareness of the mortality gap and efforts to address these health disparities, in most jurisdictions there is no actionable roadmap to advance physical and mental health care integration and delivery within mental health services, the "health home" of this population (4, 58–61).

To help inform service redesign efforts, we undertook a scoping review of the literature to understand the extent and type of evidence in relation to service delivery models and clinical practices that are used to support the integration and delivery of physical health care to individuals with SMI within mental health settings. Two research questions were addressed: [1] What service delivery models and clinical practices are used to support the delivery of physical health care to individuals with serious mental illness in mental health settings?; and [2] What are the outcomes of these models and practices?

Methods

To effectively capture the extensive scope and depth of this field, we undertook a scoping review of the academic literature. The methodology for this review was based on the framework developed by Arksey and O'Malley (62) and adhered to the reporting guidelines of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) extension for scoping reviews (63). The scoping review was registered via OSF (https://doi.org/10.17605/OSF.IO/3T9VK). Notably, the study team included clinicians, health service researchers, persons with lived experience of SMI and family members, who jointly framed the research questions, interpreted findings, and co-authored the manuscript.

Inclusion and exclusion criteria

The Substance Abuse and Mental Health Services Administration in the U.S. defines SMI as a diagnosable mental, behavioral, or emotional disorder that substantially interferes with a person's life and ability to function (7). Articles were eligible for this scoping review if: [1] the population of interest included individuals over the age of 18 living with SMI, such as bipolar disorder, treatment refractory depression or schizophrenia, with no other demographic constraints; the age cutoff of 18 was selected to focus on the adult population, as mental health needs and treatment approaches can differ between adults and minors (64); [2] articles focused on the concept of reverse integration, defined as the provision of physical health care services within mental health settings to address physical health needs and prevent physical health decline (40, 65); [3] they were published as peer-reviewed academic journal articles and book chapters; [4] they were published between January 1, 2010 and June 6, 2024, to capture the most recent studies and reflect evolving practices and developments in the field over the past decade; and [5] they were written in

English language. There were no methodological restrictions on article eligibility.

Articles were excluded if they: [1] focused on individuals without SMI (e.g., anxiety); [2] did not discuss the provision of physical health services (e.g., focused on psychosocial care); [3] targeted a single health dimension (e.g., smoking, obesity, physical fitness, metabolic health, sexual health, oral health, sleep), lifestyle modifications, or self-management skills training without attention to physical health needs comprehensively; [4] were not or not clearly stated to be set in mental health settings [5] did not describe or evaluate service delivery models or clinical practices; [6] were conference abstracts, dissertations, theses, reviews or study protocols. The decision to exclude articles focused on a single health dimension or lifestyle interventions was made to ensure the study focused on service delivery models and practices supporting the physical health needs of adults with SMI comprehensively, making the findings more relevant for service redesign efforts.

Search strategy

To locate scholarly articles, a medical librarian (TR) developed the core search strategy in MEDLINE in collaboration with the review team, then translated the search for use in other selected databases. Searches were conducted in the following four databases on July 19, 2023, and updated on June 6, 2024, using the same search strategy: MEDLINE (Ovid), Embase (Ovid), APA PsycInfo (Ovid), and CINAHL (EBSCO). The first section of the search strategy combined a robust "physical health care" concept comprised of database-specific subject headings, keywords in natural language, and advanced search operators with natural language strings of "integration" or "co-location" terms appearing within five words of terms related to mental healthcare or mental health conditions. The second section combined a "mental health care" concept with strings of "integration" or "co-location" terms appearing within five words of primary healthcare or physical health terms. The third section used subject headings that capture the programming or implementation aspects of integrated care, as well as "integration" or "co-location" keywords, which were then combined with subject headings from Sections One and Two. The results of all three sections were pooled and limited to publication years 2000 to present. No study type or language limits were applied. The full Medline strategy can be found in Supplementary Table S1.

Evidence selection

Following the search, all identified citations were uploaded into Covidence where duplicate citations were removed. Titles and abstracts were screened by two independent reviewers, SZ and TM, for assessment against the inclusion criteria for the review. The full text of selected citations were assessed in detail against the inclusion criteria by two independent reviewers. At the beginning of these phases, the senior author, VS, reviewed an initial sample of 20 review decisions made by the two reviewers to ensure consistency. Reasons for exclusion of sources of evidence at full text review were recorded and reported in the scoping review. Disagreements between the reviewers at each stage of the selection process were resolved through discussion with the senior author and/or resolved by consensus.

Data charting process and items

A data extraction template was developed by the research team to chart details about the included articles and relevant content. The domains of the data extraction form included: authors, publication year, country, article title, study type, target population/study setting, and key findings for all articles. Descriptions of the model and types of interventions were extracted. One research team member extracted the data from the included articles, which was reviewed by the senior author for accuracy and completeness. Given the nature of scoping reviews and the conceptual focus of this review, critical appraisal of article quality was not performed.

Synthesis of results

Reverse integration initiatives, especially in North America, where most studies originated from, have typically followed the principles outlined by Wagner's Chronic Care Model for the treatment of adults with chronic illness and complex health needs. This model, focused on improving health outcomes through the provision of high quality, patient-centered and evidence-based care, has been central to integrated care delivery initiatives in the US, including collaborative care models in primary care settings. Service delivery models and practices were therefore examined using Wagner's Model as a guide to identify the essential elements that encourage high-quality physical health care and chronic disease management (66, 67). A descriptive process was used to identify and synthesize the most common elements within the service models and related outcomes.

Results

A total of 10,610 records were identified through database searching across the two searches on July 19, 2023 and June 6, 2024 (10,036 records from the first search and 574 records from the second search). After removing duplicates, 7,927 titles and abstracts were screened. Following title and abstract screening, 418 articles were eligible for full-text review. Of these, 57 academic articles were included. Eight additional academic articles were included from forward and backward citation searches of the included articles, for a total of 65 academic articles (Table 1). The study selection process is presented in Figure 1. Most articles were from the United States ($n = 54$).

TABLE 1 Overview of included studies.

Authors, year	Article title	Country	Study type
Rogers et al. 2016 (55)	A Randomized Clinical Trial Investigating the Effect of a Healthcare Access Model for Individuals with Severe Psychiatric Disabilities	USA	Randomized controlled trial (RCT)
Goh et al. 2016 (75)	A retrospective study of medical comorbidities in psychogeriatric patients	Australia	Retrospective descriptive study
Scharf et al. 2014 (89)	Evaluation of the SAMHSA Primary and Behavioral Health Care Integration (PBHCI) Grant Program: Final Report	USA	Multi-method program evaluation
Scharf et al. 2014 (86)	An Examination of New York State's Integrated Primary and Mental Health Care Services for Adults with Serious Mental Illness	USA	Qualitative study
Scharf et al. 2016 (95)	General Medical Outcomes From the Primary and Behavioral Health Care Integration Grant Program	USA	Quasi-experimental study
Breslau et al. 2018 (118)	Impact of a Mental Health Based Primary Care Program on Quality of Physical Health Care	USA	Quasi-experimental study
Breslau et al. 2018 (99)	Impact of a mental health based primary care program on emergency department visits and inpatient stays	USA	Quasi-experimental study
Krupski et al. 2016 (85)	Integrating Primary Care Into Community Mental Health Centers: Impact on Utilization and Costs of Health Care	USA	Quasi-experimental study
Druss et al. 2017 (49)	Randomized Trial of an Integrated Behavioral Health Home: The Health Outcomes Management and Evaluation (HOME) Study	USA	RCT
Johnson et al. 2022 (70)	Assessing the Long-Term Effectiveness of a Behavioral Health Home for Adults With Bipolar and Psychotic Disorders	USA	Longitudinal cohort study
Druss et al. 2020 (84)	Randomized Trial of a Mobile Personal Health Record for Behavioral Health Homes	USA	RCT
Pirraglia et al. 2012 (97)	Benefits of a primary care clinic co-located and integrated in a mental health setting for veterans with serious mental illness	USA	Longitudinal cohort study
Druss et al. 2010 (92)	A Randomized Trial of Medical Care Management for Community Mental Health Settings: The Primary Care Access, Referral, and Evaluation (PCARE) Study	USA	RCT
Druss et al. 2011 (48)	Budget impact and sustainability of medical care management for persons with serious mental illnesses	USA	RCT
Cabassa et al. 2015 (45)	What would it take? Stakeholders' views and preferences for implementing a health care manager program in community mental health clinics under health care reform	USA	Qualitative study
Cabassa et al. 2019 (119)	"Treated me..Like I was family": Qualitative Evaluation of a Culturally-Adapted Health Care Manager Intervention for Latinos with Serious Mental Illness and at Risk for Cardiovascular Disease	USA	Qualitative study
Ross et al. 2018 (74)	Can We Improve Physical Health Monitoring for Patients Taking Antipsychotics on a Mental Health Inpatient Unit?.	Canada	Quasi-experimental study
McGinty et al. 2018 (108)	An innovative model to coordinate healthcare and social services for people with serious mental illness: A mixed-methods case study of Maryland's Medicaid health home program	USA	Case study
Daumit et al. 2019 (47)	Care Coordination and Population Health Management Strategies and Challenges in a Behavioral Health Home Model	USA	Multi-method program evaluation
Murphy et al. 2020 (120)	Association Between the Maryland Medicaid Behavioral Health Home Program and Cancer Screening in People With Serious Mental Illness	USA	Quasi-experimental study
Annamalai et al. 2018 (88)	Establishing an Integrated Health Care Clinic in a Community Mental Health Center: Lessons Learned	USA	Descriptive study
Uga et al. 2017 (121)	Evaluation of a Model of Integrated Care for Patients With Chronic Medical and Psychiatric Illness	USA	Quasi-experimental study
Schmit et al. 2018 (56)	Examining the Effectiveness of Integrated Behavioral and Primary Health Care Treatment	USA	Quasi-experimental study
Pratt et al. 2013 (122)	Feasibility and Effectiveness of an Automated Telehealth Intervention to Improve Illness Self-Management in People With Serious Psychiatric and Medical Disorders	USA	Single-arm feasibility study
Gilmer et al. 2016 (96)	Implementation of Integrated Health Homes and Health Outcomes for Persons With Serious Mental Illness in Los Angeles County	USA	Longitudinal cohort study
Henwood et al. 2018 (73)	Integrated Primary Care in Assertive Community Treatment	USA	Descriptive study
Tse et al. 2022 (72)	Integrating Primary Care Into Assertive Community Treatment	USA	Quasi-experimental study
Carson Weinstein et al. 2011 (123)	Transforming assertive community treatment into an integrated care system: The role of nursing and primary care partnerships	USA	Descriptive study
Smali et al. 2022 (87)	A Continuum-Based Framework as a Practice Assessment Tool for Integration of General Health in Behavioral Health Care	USA	Descriptive study
Stevens and Sidlinger 2015 (71)	Integration of Primary Care into a Mental Health Center: Lessons Learned from Year One Implementation	USA	Descriptive study
Mangurian et al. 2022 (90)	Lessons Learned From a New Reverse-Integration Model to Improve Primary Care Screening in Community Mental Health Settings	USA	Descriptive study
Bartels et al. 2014 (68)	Long-term outcomes of a randomized trial of integrated skills training and preventive healthcare for older adults with serious mental illness	USA	RCT

(*Continued*)

TABLE 1 Continued

Authors, year	Article title	Country	Study type
Tepper et al. 2017 (91)	Mind the Gap: Developing an Integrated Behavioral Health Home to Address Health Disparities in Serious Mental Illness	USA	Quasi-experimental study
Storm et al. 2020 (124)	Peer Support in Coordination of Physical Health and Mental Health Services for People With Lived Experience of a Serious Mental Illness	USA	Qualitative study
Errichetti et al. 2020 (93)	Randomized Trial of Reverse Colocated Integrated Care on Persons with Severe, Persistent Mental Illness in Southern Texas	USA	RCT
Iturralde et al. 2022 (76)	Closing the Care Gap for People with Severe and Persistent Mental Illness: Collaborative Care, Telehealth, and Clinical Pharmacy	USA	Descriptive study
Iturralde et al. 2024 (77)	Telehealth Collaborative Care Led by Clinical Pharmacists for People With Psychosis or Bipolar Disorder: A Propensity Weighted Comparison With Usual Psychiatric Care	USA	Retrospective cohort study
Tajirian et al. 2023 (57)	Recommendations to Enhance Physical Health for Individuals with Severe Mental Illness in Canadian Healthcare Organizations	Canada	Descriptive study
Ungar et al. 2013 (109)	Reversed Shared Care in Mental Health: Bringing Primary Physical Health Care to Psychiatric Patients	Canada	Descriptive study
Lambert et al. 2017 (125)	Royal Australian and New Zealand College of Psychiatrists expert consensus statement for the treatment, management and monitoring of the physical health of people with an enduring psychotic illness	Australia	Delphi study
Mouko and Sullivan 2017 (126)	Systems for physical health care for mental health patients in the community: Different approaches to improve patient care and safety in an Early Intervention in Psychosis Service	UK	Longitudinal cohort study
Brown et al. 2020 (127)	The adaptation and implementation of the Health Improvement Profile to Australian standards in public mental health settings	Australia	Descriptive study
Xuereb et al. 2020 (128)	The implementation of a physical health checklist in a psychiatric forensic unit	Malta	Pre-post study
Malachowski et al. 2019 (107)	The Integrated Health Hub (IHH) Model: The Evolution of a Community Based Primary Care and Mental Health Centre	Canada	Qualitative study
Zatloff et al. 2021 (98)	Reverse Integration Pilot in a Public Safety-Net Hospital's Outpatient Behavioral Health Clinic	USA	Pre-post study
Chambers et al. 2023 (69)	Whole person care: Outcomes from a 5-year care model integrating primary care into a behavioral health clinic	USA	Pre-post study
Eldridge et al. 2011 (105)	A well-being support program for patients with severe mental illness: A service evaluation	UK	Descriptive study
Siantz et al. 2016 (129)	Implementation of Peer Providers in Integrated Mental Health and Primary Care Settings	USA	Qualitative study
Ma and Saw 2018 (102)	A Qualitative Study on Primary Care Integration into an Asian Immigrant-specific Behavioural Health Setting in the United States	USA	Qualitative Study
Wells et al. 2019 (130)	Integrating Primary Care Into Community Mental Health Centres in Texas, USA: Results of a Case Study Investigation	USA	Case study
Connor et al. 2018 (78)	Integrating physical health: What were the costs to behavioral health care clinics?	USA	Cost analysis
Ramanuj et al. 2018 (79)	Integrating Behavioral Health and Primary Care Services for People with Serious Mental Illness: A Qualitative Systems Analysis of Integration in New York	USA	Qualitative study
Scharf et al. 2013 (81)	Integrating primary care into community behavioral health settings: Programs and early implementation experiences	USA	Descriptive study
Breslau et al. 2021 (100)	Primary and Behavioral Health Care Integration Program: Impacts on Health Care Utilization, Cost, and Quality	USA	Collective case study
Bandara et al. 2020 (101)	The effects of the Maryland Medicaid Health Home Waiver on Emergency Department and inpatient utilization among individuals with serious mental illness	USA	Retrospective cohort study
McGinty et al. 2020 (131)	Effects of Maryland's Affordable Care Act Medicaid Health Home Waiver on Quality of Cardiovascular Care Among People with Serious Mental Illness	USA	Retrospective cohort study
Stone et al. 2020 (82)	The Policy Ecology of Behavioral Health Homes: Case Study of Maryland's Medicaid Health Home Program	USA	Case study
Tatreau et al. 2016 (132)	Cardiometabolic Assessment, Diagnosis, and Treatment of Chronic Medical Illnesses During an Inpatient Psychiatric Hospitalization: Colocated Medical Care Versus Treatment as Usual	USA	Cross-sectional retrospective study
Woltmann et al. 2024 (133)	Technologic and Nontechnologic Barriers to Implementing Behavioral Health Homes in Community Mental Health Settings During the COVID-19 Pandemic	USA	Qualitative study
Flanagan et al. 2024 (103)	Care integration goes Beyond Co-Location: Creating a Medical Home	USA	Qualitative descriptive study
Burner et al. 2024 (134)	Factors to Improve Reverse Integration: A Mixed Method Embedded Design Study	USA	Qualitative descriptive study
Utter et al. 2023 (135)	Integrating primary care services in outpatient mental health treatment facilities: National and state trends, 2015–2020	USA	Repeated cross-sectional study
Kogan et al. 2017 (106)	Challenges encountered in the conduct of Optimal Health: A patient-centered comparative effectiveness study of interventions for adults with serious mental illness	USA	Cluster-RCT
Nikolajski et al. 2022 (104)	Staff Perceptions of Barriers and Facilitators to Implementation of Behavioral Health Homes at Community Mental Health Provider Settings	USA	Qualitative study
Schuster et al. 2018 (94)	A Payer-Guided Approach To Widespread Diffusion Of Behavioral Health Homes In Real-World Settings	USA	Cluster-RCT

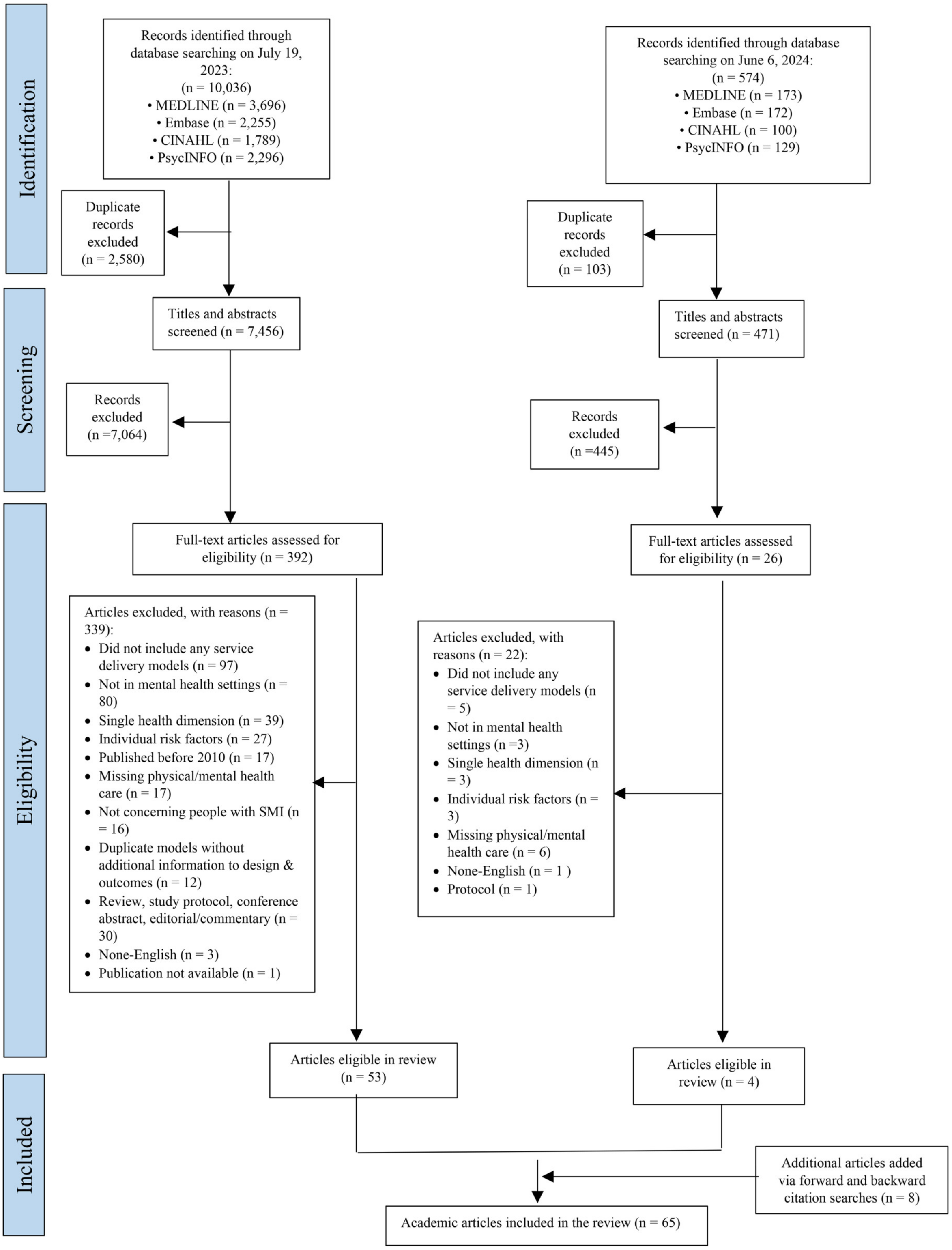

FIGURE 1
Study selection and exclusion process (PRISMA flow diagram).

Others were from Australia (*n* = 3), the United Kingdom (*n* = 3), Canada (*n* = 4), and Malta (*n* = 1).

Articles included randomized controlled trials (*n* = 9), quasi-experimental studies (*n* = 10), longitudinal cohort studies (*n* = 4), qualitative studies (*n* = 12), descriptive studies, inclusive primarily of program descriptions (*n* = 12), pre-post study designs (*n* = 3), and case studies (*n* = 4). Please see Table 1 for description of all studies.

We present below a synthesis of our findings, including a description of the integrated care models identified, individual and system-level outcomes, implementation considerations, and associated costs.

Service delivery models and clinical practices promoting physical health service delivery in mental health settings

The number of articles discussing integrated service delivery models and clinical practices increased over time: 21 articles were published from 2010 to 2016, and 44 were published from 2017 to June 6, 2024. Most of the service delivery models and clinical practices described were implemented in public sector community settings in the United States, such as community mental health centers and community-based behavioral health clinics serving adults with SMI. Commonly, initiatives integrated primary care physicians or nurse practitioners (NP) within outpatient behavioral health settings to establish on-site primary care clinics and support coordination with community-based primary health services (49, 56, 68–71). Efforts to integrate primary care physicians and NPs into Assertive Community Treatment (ACT) teams and inpatient psychiatric units to improve the assessment and treatment of physical health comorbidities in this population were also described (72–75). More recently, studies described a novel pharmacist-led collaborative care model leveraging telehealth and population-based care to support medication management, health screenings, and access to multidisciplinary services and community resources for adults with SMI in northern California (76, 77).

The services and practices discussed in the literature leverage different levels of the healthcare system, from macro-level policy levers and grant supports to deliver integrated care to micro-level direct practice changes. Macro-level initiatives, such as the Primary and Behavioral Health Care Integration (PBHCI) grant program in the US provided funding or financial incentives to integrate services for people living with SMI (78, 79). Meso-level initiatives focused on organizing and managing services at regional or organizational levels (80). These initiatives included optimizing leadership and strategic planning within organizations, regular monitoring and reporting of certain health indicators, and creating patient registries to track patients' physical health needs (81, 82). These meso-level practices aimed to bridge the gap between broad policy directives and individual patient care and ensure that healthcare services are efficient and well-integrated. At the micro level, initiatives included designated healthcare professionals to support the physical health needs of patients within mental health settings and the development of personalized care plans.

The service delivery models and practices described have generally followed one or more of the elements outlined in Wagner's Chronic Care Model (CCM) for treating individuals with complex chronic health conditions (67). The core components of Wagner's CCM include patient self-management support, delivery system design, decision support, and clinical information systems, in addition to organizational commitment to safe, high quality care, and linkage to community resources. Models varied in their description of these components; seventeen of the 51 (33.3%) distinct models described in this review appeared to include four or more components of Wagner's CCM, whereas 20 (39.2%) appeared to include two or less. Among the six CCM components, the ones most commonly addressed include delivery-system redesign (100%), patient self-management support (52.9%) and use of clinical information systems (45.15%). Access to decision support was the component least likely to be discussed in these models (21.6%), although program descriptions were often limited and components of the model may have been missed.

Delivery-system redesign refers to redefining work roles for clinicians and staff to facilitate preventive care, as well as creating new positions as needed to support the care model (67, 83). The models emphasized screening and referral for the treatment of general medical conditions, designated primary care physicians, NPs, healthcare managers, or peer support specialists to monitor physical health issues regularly, and provided psychoeducation on illness prevention (68, 84–87). Patient self-management support, as part of comprehensive care models, involved empowering individuals to recognize and manage their symptoms (66, 67, 83). The support typically combined education and skills training, often facilitated by healthcare professionals such as nurses, NPs, and care managers. Some programs included care managers and peer providers, as well as wellness specialists offering health education on lifestyle factors such as weight loss, smoking cessation, diabetes management, and heart disease prevention (49, 85, 88).

Furthermore, to provide comprehensive physical and mental health care by a multidisciplinary team or across different teams, communication and information sharing among providers is crucial (66, 67). Some studies implemented and improved processes within electronic health records (EHRs) and reminder systems to ensure efficient documentation, information flow among clinicians, and timely reminders for care coordination. For instance, all PBHCI grantees were required to develop a registry/tracking system for physical health needs and outcomes (89). Other programs have enhanced EHR functionality with features like provider alerts for patient transitions, health status registries, standardized order sets and comprehensive discharge reports (74, 90, 91).

Health indicator outcomes

Common physical health indicators assessed in the articles examined included blood pressure, blood glucose, cholesterol, and other cardiometabolic risk factors. Among the twelve studies that reported on physical health indicators, results were promising. Select findings are presented below, with study details described in Table 2.

A randomized controlled trial (RCT) by Druss et al. (92) found that integrated care participants received significantly more preventive services and had significantly lower Framingham cardiovascular risk scores compared to controls at 12 months

TABLE 2 Description of integrated care delivery models/ clinical practices and associated outcomes.

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Rogers et al. 2016 (55)	A nurse practitioner (NP) in a community mental health settings serving adults with SMI providing patient-centered care, lifestyle counseling, specialty care access, and coordination with primary care providers.	• Support of patient self-management • Delivery system redesign • Decision-making support	This randomized controlled trial included 200 participants, who were randomly assigned to the intervention group ($n = 94$) or usual care ($n = 106$) and followed for 12 months.	Individuals receiving NP services experienced significant improvements in Continuity of Care ($F = 2.73$, $df = 3{,}430$, $p = .04$) and the Community Orientation of the primary care provider ($F = 2.71$, $df = 3{,}412$, $p = .05$). There were no differences in exercise, nutrition and wellness outcomes.
Goh et al. 2016 (75)	A medical resident in an inpatient psychogeriatric unit managing medical comorbidities in psychiatric patients 65 and older.	Delivery system redesign	Retrospective file ($n = 165$) audit analyzed admissions to assess medical comorbidities and interventions.	91.5% of inpatients had at least one medical comorbidity. Medical assessments increased from 24% to 53% with the introduction of medical resident [χ^2 (2) = 15.17, $P = 0.001$]. The increase did not affect rates of emergency medical transfers, geriatric evaluation visits, or changes in non-psychiatric drug treatments.
Scharf et al. 2014 (89)	Physical and Behavioral Health Care Integration (PBCHI) grantees received $500,000 annually to coordinate access to primary care, including four core features: screening/referral for physical health needs, developing a registry/tracking system, care management, and prevention/wellness support.	• Support of patient self-management • Decision-making support • Use of clinical information systems • Delivery system redesign	This article describes an evaluation of the PBHCI grants program, including document review, program data and comparative study of 3 PBHCI clinics and 3 control clinics.	PBHCI programs varied in structure and integration features. PBHCI consumers, compared to controls, showed improvements in some (e.g., diastolic blood pressure, total and LDL cholesterol, blood glucose), but not all physical health indicators examined (e.g., systolic blood pressure, body mass index, hemoglobin A1c, triglycerides, smoking). Access to primary care and integrated care was not clearly associated with physical health outcomes.
Scharf et al. 2014 (86)	• Three initiatives aimed at integrating care for adults with SMI in New York State (NYS). • PBHCI programs: see Scharf, Eberhart, et al. 2014 (86) • Medicaid Incentive Program offered financial incentives for mental health clinics to expand their billable services offering health monitoring or health monitoring and health physicals. • Medicaid Health Homes included integrated networks of diverse healthcare providers managed by lead organization, focusing on coordinated, multidisciplinary care for patients with complex medical needs.	PBHCI programs: see Scharf et al. 2014 (86) Medicaid Incentive Program: a market incentive mechanism to promote integrated care. Medicaid Health Homes: • Delivery system redesign • Linkage to community resources	Descriptive study of three initiatives, leveraging data from site visits to nine mental health clinics and surveys with 22 mental health clinic administrators and 34 associated professionals.	PBHCI clinics were more likely to develop an integrated care culture, use registries and offer on-site comprehensive services. Medicaid Incentive clinics had limited scope, while Mental Health Homes relied on case managers and networks of organizations to offer access to primary care, focusing on care coordination. Effective clinics leveraged connections with community programs, data systems, information sharing, and strong leadership. Challenges included licensing requirements, infrastructure, information sharing, and sustainability.
Scharf et al. 2016 (95)	PBHCI program: see Scharf et al. 2014 (89)	See Scharf et al. 2014 (89).	This quasi-experimental study used a difference-in-differences design to compare changes in general medical health between consumers in PBHCI clinics ($n = 322$) and control clinics ($n = 469$) over approximately a year.	PBHCI consumers showed statistically significant improvements in total cholesterol, LDL cholesterol, and HDL cholesterol compared to control consumers. The adjusted mean reduction in total cholesterol was 36 mg/dl ($p < 0.01$), in LDL cholesterol 35 mg/dl ($p < 0.001$), and the increase in HDL cholesterol 3 mg/dl ($p < 0.05$)
Breslau et al. 2018 (99)	PBHCI program: see Scharf et al. 2014 (89). Seven New York City (NYC) outpatient mental health clinics with PBHCI programs (4 programs implemented in wave 1, and 3 implemented in wave 2).	See Scharf et al. 2014 (89).	Medicaid claims data of PBHCI patients from 2 waves of implementation ($n = 8{,}603$) and control participants ($n = 24{,}581$) from 40 New York City (NYC) clinics without primary care services were used to assess impact of PBHCI on quality of physical health care.	For wave 1 participants, there was a statistically significant ($p < 0.0001$) increase in the odds of receiving metabolic monitoring among antipsychotic users in PBHCI clinics relative to controls, and no differences on the odds of having an outpatient medical visit or diabetes monitoring. For wave 2, there were no significant differences between the PBHCI and control groups for any of the quality measures examined.

(*Continued*)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Breslau et al. 2018 (99)	PBHCI programs: see Scharf et al. 2014 (89) Seven New York City (NYC) outpatient mental health clinics with PBHCI programs (4 programs implemented in wave 1, and 3 implemented in wave 2).	PBHCI programs: see Scharf et al. 2014 (89)	Medicaid claims data of PBHCI patients from 2 waves of implementation ($n = 8,603$) and control participants ($n = 24,581$) from 40 New York City (NYC) clinics without primary care services were used to assess impact of PBHCI on emergency department (ED) visits and hospitalizations.	Hospitalizations for medical conditions increased in PBCHI clinics compared to control in both waves (OR = 1.21 for Wave 1, OR = 1.33 for Wave 2). ED visits for behavioral health conditions decreased in PBCHI clinics relative to controls in Wave 1 (OR = 0.89), but not in Wave 2. There were no other significant differences in healthcare utilization between PBCHI and control clinics.
Krupski et al. 2016 (85)	PBHCI program: see Scharf, et al. 2014 (89). An advanced NP and nurses coordinating primary and mental health care in 2 community mental health centers serving vulnerable and homeless populations in King County, Washington. Medical staff handled referrals, and peer counselors led wellness programs under nurse supervision.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Support from the health care organization • Linkage to community resources	The study compared outcomes of adults enrolled in the PBHCI centers (clinic 1, $n = 373$; clinic 2, $n = 389$) to propensity matched controls from the same sites. Clinic 1 had a 10 year history of providing integrated care, while Clinic 2 began integrating care with the PBHCI grant.	Outcomes (Clinic 1): Increased outpatient care ($p < .003$), decreased inpatient admissions ($p = .04$), trend for lower inpatient costs ($217.68, $p = .06$). Outcomes (Clinic 2): Increased outpatient care ($p < .001$), no significant inpatient cost changes.
Druss et al. 2017 (49)	The Behavioral Health Home (BHH) had a NP and a nurse care manager, supervised by the health center's director. They targeted cardiometabolic risks (blood pressure, glucose level, cholesterol level) and integrated health records with mental health teams serving adults with SMI. Patients received health education and logistical support to attend their medical appointments	• Support of patient self-management • Use of clinical information systems • Delivery system redesign	This single-blinded randomized controlled trial involved 447 adults with SMI and one or more cardiometabolic risks randomized to the BHH group ($n = 224$) or usual care ($n = 233$), which included providing participants a summary of their lab results and encouraging to see their medical provider.	BHH patients had significant improvements in cardiometabolic care (from 67% to 81%), diabetes, and hypertension care (both $p < 0.001$), with higher likelihoods of receiving appropriate medications for diabetes and hypertension. BHH patients also showed greater improvements in preventive services (from 36% to 56%) and care alignment with the chronic care model (from 2.2 to 3.6), both significantly better than usual care ($p < 0.001$).
Johnson et al. 2022 (70)	The BHH, serving patients with psychotic and bipolar disorder in an urban setting, provided referrals and co-located services with primary care, involving a NP and care manager, supported by regular meetings.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Linkage to community resources	EHR data was used to compare BHH participants ($n = 413$) with non-BHH participants ($n = 1,929$) in regards to health care utilization and chronic disease management 3.5 years post-BHH implementation	BHH participants, compared to controls, had a significant increase in primary care visits per month (+0.18 visits/month, $p < 0.01$), a significant decrease in emergency department (ED) visits per month (−0.031 visits/month, $p < 0.01$) and more general medical health outpatient visits per month (+0.055, $p < 0.01$). BHH participation was associated with significant reduction in hemoglobin A1c levels (−0.29%, $p < 0.05$), but no differences in LDL cholesterol values.
Druss et al. 2020 (84)	The Mobile Personal Health Record (mPHR) app tracked health data and goals among BHH participants with SMI and one or more cardiometabolic risk factors, with certified peer specialists trained as clinical technology specialists assisting participants in using the app.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign	This randomized controlled trial compared quality of medical care among participants randomized to receive the mPHR app ($n = 156$) or usual care ($n = 155$) over 12 months.	Participants in the intervention group received 70% of indicated cardiometabolic and preventive services at both baseline and 12-month follow-up, while the usual-care group showed a slight but statistically significant decline from 71% to 67% (F = 4.18; df = 1, 309; $p = 0.04$).
Pirraglia et al. 2012 (97)	The Serious Mental Illness Primary Care Clinic (SMIPCC) colocated and integrated in a mental health outpatient program targeting veterans with SMI with poor primary care engagement and at least one chronic medical condition, operated one session per week staffed by a primary care provider and a patient care assistant.	Delivery system redesign	This longitudinal cohort study involved chart reviews of veterans ($n = 97$) with SMI 6 months prior to enrollment and 6 months in the year following enrollment to a co-located primary care clinic.	Enrollment in the SMIPCC program was associated with a significant increase in primary care visits (median increased from 0 to 2, $p < 0.001$) and higher goal attainment for several health metrics: Blood pressure: AOR = 2.16 (95% CI, 1.47–3.18) LDL cholesterol: AOR = 1.60 (95% CI, 1.10–2.34) Triglycerides: AOR = 1.64 (95% CI, 1.06–2.51) BMI: AOR = 1.81 (95% CI, 1.29–2.54) Changes with regard to goal attainment for high-density lipoprotein cholesterol and HbA1c were not significant.
Druss et al. 2010 (92)	The Primary Care Access, Referral, and Evaluation (PCARE) model used care managers, coordinated by two full-time nurses, to support self-management, advocate for patients, maintain provider lists for population-based medical care management, and enroll uninsured patients. The target population was economically disadvantaged	• Support of patient self-management • Delivery system redesign • Linkage to community resources	A randomized controlled trial comparing the quality of care among PCARE ($n = 205$) and usual care participants ($n = 202$) at 6 and 12 months.	At 12-months, the PCARE group received significantly more recommended preventive services (58.7% vs. 21.8%, $p < 0.001$) and had better outcomes in cardiometabolic care and primary care provider access. They also showed significant improvement in the SF-12 Mental Component Score (8.0% improvement vs. 1.1% decline, $p = 0.008$), and had lower Framingham Cardiovascular Risk Scores compared to the control group (6.9% vs. 9.8%, $p = 0.02$).

(*Continued*)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
	adults with SMI in an urban community mental health center.			
Druss et al. 2011 (48)	PCARE model. See Druss et al. 2010 (92).	See Druss et al. 2010 (92).	Study evaluated two-year outcomes, costs, and financial sustainability of a medical care management intervention in community mental health settings via chart reviews of PCARE participants and interviews.	At 2 years, the intervention group, compared to usual care, showed sustained improvements in quality of primary care preventive services, cardiometabolic care, and mental health-related quality of life (all at $p < 0.001$), with a reduced total cost by $932 by year 2. The program was not sustainable without grant funding as only 40.5% of participants had health insurance.
Cabassa et al. 2015 (45)	An adaptation of the PCARE model using social workers instead of RNs to deliver the intervention in outpatient mental health clinics in Northern Manhattan serving predominantly Hispanic patients with SMI. See Druss et al. 2010 (92) for the PCARE model.	See Druss et al. 2010 (92).	20 stakeholders (mental health providers, primary care providers, administrators and consumer advocates) participated in semi-structured qualitative interviews to assess the feasibility and acceptability of implementing an adapted PCARE model at a public mental health outpatient clinic.	Stakeholders valued PCARE's care coordination, physical health focus, and liaison role of the health care manager. Concerns included integrating into routine care and staff workloads. A blend of implementation strategies was recommended (e.g., financial, restructuring, cultural adaptation) to move this intervention into practice.
Cabassa et al. 2019 (119)	Bridges to Better Health and Wellness (B2BHW) healthcare managers connected patients of a public outpatient mental health clinic in New York City to primary care, ensured patients' medical information was shared across levels of care, monitored patients' health, and alerted providers when preventive primary care services were needed.	• Support of patient self-management • Delivery system redesign • Decision-making support	The study included a survey ($n = 29$) and 3 focus groups ($n = 16$) of participants receiving the B2BHW intervention.	Participants valued the respectful, supportive relationships with healthcare managers, the health education they received, as well as care coordination and patient activation which reflected cultural norms and addressed key barriers to care.
Ross et al. 2018 (74)	Implementation of a standardized electronic order set in an acute inpatient psychiatry ward promoting specific health investigations for patients prescribed a regularly scheduled antipsychotic medication for 3 or more days.	• Use of clinical information systems • Delivery system redesign	A chart audit focused on patients prescribed antipsychotics for 3 or more days before ($n = 96$) and after implementation ($n = 190$) of a standardized order set.	The implementation of the standardized electronic order set significantly improved ($p < 0.05$) physical health monitoring rates for blood glucose, lipids, ECG, and thyroid-stimulating hormone (TSH) in patients with SMI on antipsychotic medications (monitoring rates for blood glucose, lipids ECG and TSH improved from 31%, 36%, 51% and 71% to 96%, 64%, 87% and 86% respectively). Intervention rates for abnormal physical health results remained low.
McGinty et al. 2018 (108)	Maryland's Medicaid Behavioral Health Home (BHH) Program included a director, nurse care managers, and primary care consultants to provide individualized care plans, care coordination, health promotion, transitional care, support services, and community referrals to eligible participants followed by psychiatric rehabilitation programs ((PRPs) serving adults with SMI in Maryland.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Linkage to community resources	This case study, using interviews with 72 BHH implementation leaders and a survey of 627 frontline staff, examined the implementation of Maryland's BHH program in 46 out of 48 active programs during the study period.	BHH program structure varied across sites. 93% of staff supported integrating somatic health services in PRPs, though 37% preferred focusing more on social services, indicating tension in service priorities. Despite good organization fit, implementation challenges included health IT usability, population health management capacity and coordination with external providers.
Daumit et al. 2019 (47)	Maryland Medicaid Behavioral Health Home (BHH) Program, see McGinty et al. 2018 (108).	See McGinty et al. 2018 (108).	The study, using interviews with 72 BHH leaders and a survey of 627 frontline staff from 46 of 48 active programs, examined providers' perceptions of and capacity to address BHH implementation barriers in community health centers in Maryland.	Population health management was challenged by tensions with direct clinical care provision, limited staff experience and state regulations for service delivery. While engaging primary care providers (PCPs) was the main barrier to care coordination, health information technology usability and staffing were barriers to both care coordination and population health management.

(Continued)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Murphy et al. 2020 (120)	Maryland Medicaid Behavioral Health Home (BHH) Program, see McGinty et al. 2018 (108).	See McGinty et al. 2018 (108).	Using administrative data, the study examined the association between cancer screening and enrollment in a BHH ($n = 3,298$, 27%) vs. no enrollment ($n = 8,878$, 73%). Participants were adults in Maryland's psychiatric rehabilitation programs for who were eligible for cervical ($n = 6,811$), breast ($n = 1,658$), or colorectal cancer screening ($n = 3,430$).	BHH enrollment was associated with increased cervical (odds ratio [OR] = 1.20, 95% confidence interval [CI] = 1.07–1.35; $p = 0.002$)) and breast (OR = 1.30, 95% CI = 1.06–1.59; $p = 0.01$) cancer screening rates but not colorectal cancer screening. Predicted annual screening rates for BHH-enrolled individuals were higher but remained suboptimal, at 31% for cervical and 28% for breast cancer.
Annamalai et al. 2018 (88)	The Connecticut Mental Health Center (CMHC) Wellness Center is an on-site primary care clinic formed in partnership between the CMHC and a FQHC. The Wellness Centre provides health promotion programs for prevention and management of chronic health conditions. For specialty services, patients are referred to community or hospital-based practices.	• Support of patient self-management • Delivery system redesign	The authors describe the development of the on-site clinic and lessons learned during implementation.	The authors highlighted the importance of funding and leadership support, of developing a shared work culture and commitment between participating organizations, ongoing data monitoring, and hiring staff comfortable with integrated care and SMI challenges.
Uga et al. 2017 (121)	An integrated care clinic providing primary care and psychiatric services by dually-trained internists/psychiatrists, enhancing care coordination and communication for patients with chronic comorbid physical and psychiatric illnesses in academic outpatient clinics.	• Delivery system redesign • Use of clinical information systems	The study compared the quality of life, care satisfaction, and care utilization in participants from an integrated medicine and psychiatry clinic ($n = 64$) and participants from separate internal medicine and psychiatry clinics ($n = 52$) within the same institution.	Patients treated in the integrated clinic reported greater satisfaction with care for both medical ($p < 0.01$) and psychiatric ($p < 0.01$) illnesses, though quality of life was similar between the groups. There was a non-significant trend toward fewer emergency room visits and fewer hospital stays for the integrated care group.
Schmit et al. 2018 (56)	An integrated behavioral and primary healthcare (IBPH) approach including monthly or bimonthly medical services by primary care physicians or NPs within a rural community mental health agency serving adults with SMI, facilitated by specialized case managers who ensured care continuity and provided preventive health services.	• Support of patient self-management • Delivery system redesign	A quasi-experimental pre–post study using health record data to compare the effectiveness of IBPH ($n = 98$) vs. behavioral treatment as usual (TAU) ($n = 98$) in improving holistic functioning over 12 months.	Participants in the IBPH group experienced a 24 times greater improvement in overall functioning compared to TAU, based on profile analysis of 5 mean difference scores capturing different domains of holistic functioning.
Pratt et al. 2013 (122)	A tailored automated telehealth intervention supported by nurse offering healthcare management monitoring responses, providing feedback, and facilitating follow-up care for adults with SMI and chronic medical conditions served by a community mental health center.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign	This single arm pilot trial ($n = 70$) examined the feasibility, acceptability and potential effectiveness of the intervention over 6 months.	The intervention was deemed acceptable and feasible, with 89% of those engaged participating in >70% of sessions. Participation was associated with improvements in self-efficacy in managing depression [$t(59) = 2.33$; $p = 0.023$] and blood pressure [$t(59) = 2.81$; $p = 0.008$] and better understanding of their medical condition.
Gilmer et al. 2016 (96)	The study examined 2 models of integrated health homes in Los Angeles County: Model 1: Five mobile Housing First (HF) teams using ACT, with a FQHC providing general medical services and integrated field-capable clinical care. Model 2: Five integrated clinics pairing community mental health centers with FQHCs. Both models aimed to offer coordinated primary, mental health, and substance use care within an integrated multidisciplinary team for adults with SMI.	• Support of patient self-management • Delivery system redesign • Support from the health care organization • Use of clinical information systems • Linkage to community resources	This study combined site visits to assess the degree of integration in each setting with longitudinal program data on physical health, mental health recovery, and chronic condition screenings.	Participants in better integrated programs, compared to those in less integrated programs, showed greater improvements in physical health status and mental health recovery, higher screening rates for common health conditions and greater reductions in hypertension, but an increase in prediabetes and diabetes (all at $p < 0.01$). Highly integrated programs had better scores for use of peer support, engaging participant social supports, continuous quality improvement, care coordination, and care management.

(Continued)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Henwood et al. 2018 (73)	Five Housing First (HF) teams using ACT in Los Angeles County paired with FQHCs for general medical care using one of tree approaches: collocating ACT at a FQHC, integrating a primary care provider in ACT, or having primary care providers divide their time between ACT and FQHC.	See Gilmer et al. 2016 (96).	Site visits were conducted to examine how partnerships with FQHCs enable the provision of integrated care within HF ACT teams and assess screening rates for blood pressure, cholesterol and blood glucose.	Screening rates varied across the 5 programs. The type of partnership or model may be less important than effective communication between staff in determining integration success and better screening rates.
Tse et al. 2022 (72)	Primary care NPs in a postgraduate fellowship program in a FQHC assigned to five ACT teams in New York City for 2 days per month conducting field visits, joining wellness groups, managing walk-in visits, and consulting with ACT psychiatrists.	Delivery system redesign	Focus groups explored the care experiences of 20 staff members and 16 ACT participants from 5 ACT teams. Screening rates for hemoglobin A1c and cholesterol among the 5 ACT team participants ($n = 305$) over time were compared with control participants served by an ACT team with no integrated primary care ($n = 73$).	There was improved primary care engagement and an increase in cholesterol (from 16% to 36%) and hemoglobin A1C screenings (from 12% to 34%) for ACT participants receiving integrated care ($p < 0.001$), although field visits were found to be an inefficient use of time for NPs.
Carson Weinstein et al. 2011 (123)	Two Housing First ACT teams in Philadelphia with embedded primary care physician one day/week, nurse training in Guided Care, and enhanced electronic documentation system delivering integrated care on-site, in homes, and at the physician's hospital-based medical home.	• Use of clinical information systems • Delivery system redesign • Decision-making support • Linkage to community resources	A program description	By embedding primary care providers, redefining the ACT nurse's role to include a broader range of health care responsibilities and providing nurses with training and guidelines, ACT teams can effectively deliver integrated health care.
Smali et al. 2022 (87)	Use of a General Health Integration (GHI) framework to assess practices in community behavioral health settings in New York and identify opportunities to advance integration of general health care.	• Support of patient self-management • Delivery system redesign • Decision-making support • Linkage to community resources	Eleven behavioral health clinics in New York City serving 7,143 clients were introduced to the framework through webinars. Participants completed an online survey to assess their integration status and provide feedback on the tool's utility in guiding integrated care.	Clinics identified strengths in trauma-informed care, social service linkages, self-management support and quality improvement. Improvement opportunities were identified in screening and referral, evidence-based treatments, care teams and sustainability. Clinics reported positive experiences using the framework.
Stevens and Sidlinger 2015 (71)	A primary care clinic in a behavioral community mental health center serving adults with SMI, offering illness screening, exams and disease management.	• Support of patient self-management • Delivery system redesign • Support from the health care organization	Description of program implementation through a partnership between a local hospital, a school of nursing and a behavioral community health center.	In the first year, 325 patients were served with over 800 visits, and a reported productivity in face to face patient encounters of 99.85%.
Mangurian et al. 2022 (90)	The intervention (CRANIUM) added a remote primary care consultant and a peer navigator to an urban mental health team, used a registry to track lab results from EHRs, and focused on screening and evidence-based treatment.	• Use of clinical information systems • Delivery system redesign • Decision-making support	Electronic health records data, provider feedback, and patient screening rates, assessed feasibility of implementation, while cost analysis and process mapping assessed resource use.	High provider adoption and satisfaction with 7% increase in metabolic screening rates and increased HIV testing (from 1% to 17%). Limited sustainability due to short-term funding and difficulty maintaining patient registry.
Bartels et al. 2014 (68)	The HOPES (Helping Older People Experience Success) program combined 12 months of weekly psychosocial skills training with biweekly community practice trips and monthly visits from an embedded nurse for screenings, advance care planning, and primary healthcare coordination, followed by 1-year maintenance phase of monthly sessions.	• Support of patient self-management • Delivery system redesign • Decision-making support • Linkage to community resources	A randomized controlled trial engaging two community mental health centers to compare HOPES ($n = 90$) to usual care ($n = 93$) for adults with SMI >50years at 1, 2, and 3 years post randomization. Assessments of functioning, symptoms and service use involved self-reports, case manager ratings, and performance-based tasks.	HOPES was associated with improved community living skills [F (2,151) = 5.10, $p = 0.007$], lower psychiatric symptom severity, and higher rates of preventive healthcare screenings (eye exams, hearing tests, mammograms and Pap smears) at 3 years, with the greatest between-group difference found for receipt of mammograms and Pap smears (NNT = 5.5 and 3.5, respectively). Further, there was an almost twofold difference between HOPES and control participants for completing advance directives (NNT = 3.6). There were no differences in the number of medical conditions, health status or acute care use at 3 years.

(Continued)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Tepper et al. 2017 (91)	An integrated behavioral health home (BHH) focused on adults with psychotic or bipolar disorder, expanding on-site medical care and health promotion, improving electronic health record (her) functionality, adding NP, care manager, and program manager, and offering team-based care with a focus group therapy, social inclusion, on disease screening and monitoring and population management.	• Support of patient self-management • Delivery system redesign • Use of clinical information systems • Linkage to community resources	This quasi-experimental study used electronic health record date to compare outcomes among 424 BHH patients and a propensity matched control group of 1,521 individuals from the same health system a year before and after the BHH intervention.	ED visits significantly decreased among BHH patients (from 1.45 to 1.19 visits) compared to the control group, whose ED visits increased (from 0.99 to 1.16, $p = 0.014$). Psychiatric hospitalizations per capita significantly decreased for BHH patients (from 0.22 to 0.10) but remained stable in the control group ($p = 0.002$). There were no significant differences in medical hospitalizations. HbA1c screening rates increased significantly more among BHH patients (from 49% to 64%), compared to the control group (from 40% to 46%, $p = 0.026$) but there were no differences in lipid monitoring and no differences in changes in metabolic monitoring parameters among patients with diabetes.
Storm et al. 2020 (124)	Peer providers in six community mental health centers, using their personal experiences to connect individuals with essential resources and services, and coordinate physical and mental health care.	• Support of patient self-management • Delivery system redesign • Linkage to community resources	Qualitative study engaging 23 mental health professionals and 5 peer specialists in semi-structured interviews exploring peer specialists roles in coordinating physical and mental health care.	Peer specialists assisted adults with SMI through advocacy, practical and emotional support, connection to resources, health care visit preparation, mutuality and sharing of experiences. Securing funding and sustaining the same group of peer specialists over time was challenging.
Errichetti et al. 2020 (93)	A multidisciplinary team including primary care physician, nurses, dietician, medical support staff, and care coordinators, collocated in behavioral health clinic in Southern Texas serving adults with SMI who lacked primary care provider.	• Delivery system redesign • Use of clinical information systems	Randomized trial evaluating the effect of integrated care (at least two visits with a primary care provider and one visit with a chronic care nurse or dietician) on adults with SMI and co-morbid chronic illness. Health outcomes, including blood pressure, HbA1c, BMI, cholesterol, and depressive symptoms, were measured at baseline, 6 and 12 months in participants in the intervention ($n = 249$) and usual care groups ($n = 167$).	Intervention participants showed significantly lower systolic blood pressure (adjusted mean difference −3.86, $p = 0.04$) and average HbA1c (adjusted mean difference −0.36, $p = 0.001$) at 12 months compared to controls. There were no significant differences in diastolic blood pressure, body mass index, cholesterol or depressive symptoms.
Iturralde et al. 2022 (76)	A population-based treatment model utilizing advanced practice clinical pharmacists as care continuity navigators for patients with serious mental illness (SMI). The program, including pharmacist-led collaborative care, population management and telehealth within a large health care system in Northern California, provided individuals with SMI medication management, health screenings, and access to multidisciplinary services and community resources.	• Support of patient self-management • Delivery system redesign • Use of clinical information systems • Linkage to community resources • Support from the health care organization	The authors describe the development of a novel Population Care Model for adults with SMI.	87% of outreached patients had an intake assessment, and of those, 73% attended a follow-up appointment. Program received high patient satisfaction ratings (93/100).
Iturralde et al. 2024 (77)	See, Iturralde et al. 2022 (76)	See, Iturralde et al. 2022 (76)	Using electronic health record data, the study compared program enrollees ($n = 968$) with SMI at 6 demonstration sites (Population Care- PC) to propensity matched patients with SMI at 6 non-program sites (Usual Care- UC) ($n = 8{,}339$). Difference-in-difference analyses assessed changes in outcomes from 12 months pre- to 12 months post-enrollment. Primary outcomes included optimal psychotropic medication adherence, guideline-recommended glycemic screening, annual psychiatrist visits, and emergency department use.	PC participants showed significantly greater achievement of psychotropic medication adherence (ARD = 6.4; 95% CI = 2.5–10.4) and glycemic screening (ARD = 9.3; 95%CI = 5.0–13.7) from pre- to post-enrollment compared to UC. Annual psychiatrist visits decreased more among PC compared to UC participants (ARD = −5.8; 95% CI = −10.0 to −1.5). PC participants showed an increase in the receipt of lipid tests (ARD = 13.0; 95% CI = 8.1–17.9) and increased EKG evaluations (ARD = 6.8; 95% CI = 2.0–11.5). Pre to post enrollment changes in mental health related ED use, hospitalization, and primary care visits were not significantly different between PC and UC.

(*Continued*)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Tajirian et al. 2023 (57)	Strategies to advance integrated care in a large academic psychiatric hospital in Toronto, Canada, included a mobile nursing team, daily hospitalist presence, educating healthcare professionals, developing hospital partnerships to minimize external transfers, use of protocols and order sets and optimizing the EHR for better outcome measurement and communication.	• Use of clinical information systems • Delivery system redesign • Decision-making support • Support from the health care organization	Description of development and implementation of integrated care strategy.	Health professional education and upskilling, strategic partnerships with general hospitals, enhancing HER functionality and leadership support deemed essential for advancing integrated care in mental health setting.
Ungar et al. 2013 (109)	A primary care physician and an ACT nurse are available for appointments at a health clinic co-located with the Mental Health Community Day Treatment, Outpatient, and Outreach Services of an academic hospital in Toronto, Canada, one morning per week.	• Delivery system redesign • Support from the health care organization	Program description The pilot involved 51 patients: 25 were seen during the first three months (January–March 2010), and 26 additional patients over the next seven months (April–October 2010). Over the three months, 50 office visits were conducted, comprising 25 first visits and 25 repeat visits, with six no-shows.	The program successfully engaged 51 patients with SMI in 51 first and 109 repeat visits offering assessment, treatment and referrals to appropriate health services. Key challenges included securing financial and administrative support, addressing perceptions of increased costs, and overcoming institutional resistance to integrating services across departments.
Lambert et al. 2017 (125)	Royal Australian and New Zealand College of Psychiatrists expert consensus statement for the management of the physical health of people with a psychotic illness offering assessment and follow up checklists for providers, and clarifying practice expectations for providers and organizational leaders.	• Support of patient self-management • Delivery system redesign • Decision-making support	Delphi method used to reach consensus on strategies for physical health management of adults with SMI, engaging 55 clinicians, 21 carers, and 20 consumers.	Endorsed strategies included need for partnerships, training and upskilling, support with screening and self- management and development of key performance indicators.
Mouko and Sullivan 2017 (126)	Strategies to increase physical health assessments in an Early Intervention in Psychosis program in Bath and north East Somerset included adding education and data collection tools, a mobile physical health clinic, and reminder letters to complete health checks.	• Use of clinical information systems • Delivery system redesign • Decision-making support	Phased improvement intervention evaluating the effect of various strategies in improving rates of physical health monitoring. Four intervention phases were tested: increased awareness and clinical tools, mobile health clinics, GP reminder letters, and a combination of these approaches.	After phases 1–3, physical health checks improved from 0% to 43.9%, blood tests from 6.3% to 74.4%, and ECGs from 3.8% to 45.1%. Phase 4 showed sustained success, with 48% of patients completing all health checks, blood tests (64.6%), and ECGs (92.3%). Mobile health clinics had physical health check completion rates of 60%, and blood tests in 70%.
Brown et al. 2020 (127)	The adapted Health Improvement Profile (HIP) for Australia, assessing the physical health of mental health service users, including vaccination, smoking cessation, diet, exercise, sleep, substance use, and routine health exams, implemented in a 50 bed psychiatric inpatient unit and a community mental health center in Australia.	• Delivery system redesign • Decision-making support	Evaluation of the implementation of the adapted HIP, including HIP completion rates and clinician ($n = 29$) and service user ($n = 12$) surveys of their experiences using the adapted HIP.	HIP forms were completed for 54% ($n = 137$) of inpatient users and 15% ($n = 34$) of community service users. Clinicians and service users found the HIP to be an acceptable screening tool.
Xuereb et al. 2020 (128)	Introduction of a physical health checklist for Forensic Unit admissions in a hospital in Malta, including vital signs, cardiovascular, respiratory, abdominal, and neurological exams.	Delivery system redesign	Chart audit of comprehensiveness of physical health assessments before ($n = 48$) and after ($n = 41$) checklist implementation.	Checklist implementation resulted in an increase in physical health documentation from 65% to 98% of consecutive admissions. Documentation of cardiovascular, respiratory, and gastrointestinal exams improved from 27% to 98% and neurological exams from 17% to 90%.
Malachowski et al. 2019 (107)	The Integrated Health Hub (IHH) in a community mental health center in Ontario, Canada, featuring a Nurse Practitioner (NP) led primary care clinic and as needed psychiatric consultations providing comprehensive care to adults with mental illness in collaboration with community partners.	• Delivery system redesign • Support from the health care organization • Linkage to community resources	Qualitative study including 7 semi-structured interviews and 3 focus groups of 22 participants exploring the evolution of the IHH	Key to the development of the IHH was communication at all levels, an organic, flexible approach to program development, strong and committed leadership, staff engagement and support, and addressing competing priorities.

(Continued)

TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Zatloff et al. 2021 (98)	Primary care clinic in an outpatient behavioral health center serving adults with SMI in Atlanta, providing primary care services alongside psychiatric and behavioral healthcare.	Delivery system redesign	Retrospective chart review comparing medical outcomes and care utilization patterns for 147 patients the year prior and following introduction of the primary care clinic.	ED visits significantly decreased [$t(146) = 3.98$, $p < 0.001$] and Primary Care appointments significantly improved [$t(136) = 14.50$, $p < 0.001$] post implementation. Medical outcome changes (HbA1c, cholesterol, blood pressure, body mass index) were not significant.
Chambers et al. 2023 (69)	This PBHCI program established a full scope primary care clinic co-located with behavioral health services in Western New York. Medical directors from family medicine and psychiatry oversaw patient care. The program relied on physician assistants, nurses, case managers, peer workers, and specialized staff for coordination and whole-person care.	• Delivery system redesign • Support from the health care organization • Linkage to community resources	A retrospective chart review of 532 adults with SMI who completed at least two National Outcome Measures (NOMs) assessments over a four-year period (2015–2019).	Significant reductions were observed in the percentage of participants with blood pressure $\geq$120/80 mmHg (27.4% to 20.0%, $p < 0.05$) and total cholesterol $\geq$200 mg/dl (12.0%–8.3%, $p < .05$). Waist circumference and breath CO worsened significantly over the study period.
Eldridge et al. 2011 (105)	The Well-Being Support Program (WSP) was a four-session package delivered by trained mental health practitioners in South East England. Key program components included physical health screening, lifestyle interventions, referral to appropriate services and strengthening primary-secondary care links.	• Support of patient self-management • Delivery system redesign	Evaluation of the WSP over a year, leveraging program enrollment data and qualitative interviews with 6 providers.	Of the 754 enrolled patients, 159 (21%) completed the program. Mean change in BMI was not statistically significant. A significant improvement in blood pressure was observed in 17 patients (14%), while 18 patients (15%) showed worsening hypertension. Qualitative feedback was largely positive.
Siantz et al. 2016 (129)	Integrated behavioral health pilot programs including peer providers serving adults with SMI in Los Angeles County Department of Mental Health (DMH). The pilot programs included five co-located primary and behavioral health care programs, eleven partnerships coordinating care across different sites, and five Housing First ACT teams.	Delivery system redesign	Site visits, chart reviews, semi-structured interviews with providers and clinic observations evaluating the implementation of peer services in 24 integrated care programs.	15 of 24 programs included peer providers, with varying roles across program types. 10 of 14 integrated programs had infrastructure for training and supervision of peer providers. A culture of stigma influence use of peer providers.
Ma and Saw 2018 (102)	Three primary care providers integrated into a large community mental health clinic in California, serving low income Asian immigrants. Patients saw primary care physicians every three months, with bilingual care managers assisting.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Support from the health care organization	Qualitative study including 5 semi-structured interviews with providers and seven focus groups with 41 patients, exploring facilitators and barriers to primary care-behavioral health integration in a multilingual setting.	Workforce limitations and payment structures hindered care integration. Improving organizational culture and practice, communication, and patient engagement facilitated successful implementation and improved outcomes.
Wells et al. 2019 (130)	Primary care practices in ten community mental health centers CMHCs) in Texas leveraging Medicaid 1115 waiver funding to integrated primary care into existing mental health services for adults with SMI: four CMHCs hired primary care providers, four partnered with federally qualified health centers, and two contracted with independent providers.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Support from the health care organization	Case study including site visits to 10 CMHCs, 66 interviews with leadership and staff and focus groups with 75 patients as well as follow-up phone interviews with key staff informants one year later.	Findings highlight the importance of the scope of services provided on-site, and of communication and coordination between providers, as well as success in scaling up integration quickly despite challenges in provider and patient recruitment and retention. Patients reported positive experiences with integrated care.
Connor et al. 2018 (78)	Two levels of integrated physical health services in 22 behavioral health clinics in New York State: 1. Health Monitoring (HM), including regular assessment of health indicators (blood pressure, BMI, smoking, activity level). 2. HM plus Health Physicals (HM/HP), including HM plus annual comprehensive physical evaluations	Delivery system redesign	Cost analysis using data collected from interviews and financial reports from 14 clinics providing HM and 8 clinics providing HM/HP.	The mean annual budgets for HM and HM/HP clinics were $2.2M and $3.1M respectively. Direct costs for HPs were $67 per visit and for HM $18 per visit, with annual care coordination costs $66,700 in HM clinics compared to $67,200 in HM/HP clinics.

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TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Ramanuj et al. 2018 (79)	11 behavioral health settings in New York City offering integrated care through the Primary and Behavioral Healthcare Integration (PBHCI) initiative and 3 Federally Qualified Health Centres (FQHCs) offering integrated care through PBHCI or the Delivery System Reform Incentive Program (DSRIP).	PBHCI: see Scharf, et al. 2014 (89).	Qualitative study engaging 36 senior clinicians and administrators in group interviews and 16 frontline staff in individual interviews exploring barriers and facilitators to integrated care.	Facilitators included teamwork, co-location of care, and care coordination. Barriers included regulatory fragmentation, licensing, and reimbursement mechanisms. Organizational culture and leadership were important mediators of integrated care.
Scharf et al. 2013 (81)	56 behavioral health grantees across 26 U.S. states funded through the Primary and Behavioral Health Integration Initiative (PBHCI) to establish: screening, assessment, and referral of adults with SMI for general medical illnesses and risk factors; a registry or tracking system for physical health needs/outcomes; care management; prevention and wellness support services.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Support from the health care organization	Data were collected from grantee proposals, semi-structured interviews with core staff, and quarterly reports to assess early implementation experiences.	Grantees varied in size, location, and service integration approaches. Implementation barriers included space constraints, staff recruitment and retention, data management, and patient recruitment.
Breslau et al. 2021 (100)	Primary and behavioral Health Integration Initiative (PBHCI): see Scharf, et al. 2014 (89).	PBHCI: see Scharf et al. 2014 (89).	Medicaid claims data was used to estimate the impact of PBHCI grants on utilization, costs of care, and quality, using a difference-in-differences model to compare PBHCI grantee clinics with comparison clinics.	PBHCI successfully reduced frequent use of emergency and inpatient services for physical health conditions, lowered care costs, and improved follow-up after hospitalization for mental illness. The effect on quality of preventive care and health monitoring for chronic physical conditions was mixed.
Bandara et al. 2020 (101)	Maryland's Behavioral Health Home (BHH) program, implemented in psychiatric rehabilitation programs (PRPs) for adults with SMI focuses on six core areas: comprehensive care management, care coordination, health promotion, comprehensive transitional care and follow-up, individual and family support, and referrals to community and social support services.	• Support of patient self-management • Use of clinical information systems • Delivery system redesign • Support from the health care organization	Medicaid claims data for 12,232 individuals with SMI enrolled in a PRP (3,319 enrolled in BHH; 8,913 non enrolled in BHH) was examined to assess BHH impact on healthcare utilization.	BHH enrollment was associated with reduced probability of all-cause (PP: 0.23 BHH enrollment vs. 0.26 non enrollment: $p < 0.01$), and physical health ED visits (PP: 0.21 BHH enrollment vs. 0.24 non enrollment, $p < 0.01$) and no effect on inpatient admissions.
McGinty et al. 2020 (131)	Maryland Medicaid BHH, see Bandara et al. 2020 (101).	See Bandara et al. 2020 (101)	Retrospective cohort analysis using administrative data to compare quality of cardiovascular (CVD) care among adults with SMI and diabetes (914 BHH enrolled; 1,691 non- BHH enrolled) and CVD (601 BHH enrolled; 1,298 non-BHH enrolled) before and after BHH implementation.	BHH enrollment was associated with increased likelihood of receiving an annual eye exam for participants with diabetes (OR 1.86, 95% CI 1.19–2.91), but no changes in other care quality measures (e.g., HbA1c, diabetic nephropathy, and cholesterol testing).
Stone et al. 2020 (82)	Maryland Medicaid BHH, see Bandara et al. 2020 (101).	See Bandara et al. 2020 (101)	The study examines the Maryland's policy environment supporting BHH implementation using the policy ecology framework.	Existing policies fail to address key implementation barriers, including difficulties coordinating with external providers, inadequate health IT, lack of population health management capacity, staffing shortfalls, and consumer engagement issues.
Tatreau et al. 2016 (132)	A physician's assistant supervised by a family physician providing reverse collocated care (RCL) through daily coverage to an inpatient psychiatric unit serving adults with SMI in North Carolina, offering admission consultations, treating patients with comorbid medical conditions, and obtaining necessary lab values.	Delivery system redesign	Chart review to compare the screening and treatment of medical comorbidities among adults consecutively admitted to two psychiatric units and discharged on second generation antipsychotics; one unit ($n = 220$) offered RCL and the second ($n = 232$) offered treatment as usual (TAU).	The TAU group had significantly more screening lab tests including HbA**1c** tests (56% vs. 16%, $p < 0.001$), glucose (99% vs. 66%, $p < 0.001$), and lipids (61% vs. 20%, $p < 0.001$), but RCL group had higher responses to abnormal tests. Patients in the RCL group were more likely to be diagnosed with obesity, tobacco use disorder, and hyperlipidemia and receive treatment for hypertension and hyperlipidemia (76% vs. 58%, $p < 0.001$ for hypertension; 37% vs. 8%, $p < .005$ for hyperlipidemia).

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TABLE 2 Continued

Authors year	Description of the Integrated Care Model/Clinical Practice	Type of intervention	Study description	Key findings
Woltmann et al. 2024 (133)	Community mental health programs with behavioral health homes (BHHs) serving adults with SMI in Maryland and Michigan during the COVID pandemic. BHHs offer coordinated physical health care, health promotion, individual and family support, and referrals to community and social support services	• Delivery system redesign • Support of patient self-management • Use of clinical information systems • Support from the health care organization	Through interviews with among 72 providers across 21 sites, the study explored barriers and strategies for implementing and sustaining BHHs during the pandemic.	Patients struggled with access and effective use of digital platforms, while staff reported service disruptions, difficulties monitoring vital signs remotely and maintaining strong collaboration with primary care providers. Additionally, participants perceived virtual encounters as less effective than in-person sessions.
Flanagan et al. 2024 (103)	Co-location of a primary care center (PCC) and a community mental health center (MHC) in a mid-sized city in northeaster US serving adults with SMI; PCC and MHC providers have separate systems, communicate via phone/email about shared patients and meet only as needed.	• Delivery system redesign • Support from the health care organization	Five focus groups with 48 participants (providers, administrators, patients), and 2 online surveys examined the integration of PCC and MHC services. 50 participants responded to the first online survey and 41 to the second survey.	There was limited staff awareness of the PCP in the first year and co-location alone was not sufficient to promote integrated care. There was a desire to strengthen integration via shared medical records and enhanced communication between providers.
Burner et al. 2024 (134)	A certified community behavioral health clinic (CCBHC) in Midwestern US incorporating primary care into their outpatient clinic to offer integrated services to adults with SMI in a Midwestern US community via close onsite collaboration and shared systems (e.g., scheduling and medical records)	• Delivery system redesign • Use of clinical information systemsLinkage to community resources	Using qualitative interviews and surveys with 40 patients and 5 providers, the study assessed patient and provider needs, satisfaction, and level of care integration.	Patients using integrated primary care reported higher satisfaction (average score 4.9, SD 0.32) and stronger intent to keep seeing their providers (score 5.0, SD 0.0) compared to those in non-integrated care. Co-location alone, without effective communication and practice changes, was insufficient to achieve true integration.
Utter et al. 2023 (135)	Integrated care in outpatient mental health treatment facilities in the US, typically involving a multidisciplinary team developing a single treatment plan, collectively monitoring patient progress, and coordinating care through shared payment and billing structures.	• Delivery system redesign • Support from the health care organization	A secondary analysis of publicly available facility level data ($n = 9{,}889$) to assess the integration of primary care services in specialty outpatient mental health facilities over time.	While integrated care increased modestly from 2015 to 2020, overall prevalence remains low at 17.5% of facilities. Access to integrated services varies by state, with several regions showing declining availability.
Kogan et al. 2017 (106)	One of two distinct care approaches implemented across 11 community mental health providers in Pennsylvania serving adults with SMI: 1. Patient Self-Directed care: used a secure web portal to offer patients support, education and resources in learning about their health and taking an active role in their care 2. Provider-Supported care: involved registered nurses supporting patients with care coordination, provider communications, and wellness supports and resources	• Support of patient self-management • Delivery system redesign • Support from the health care organization • Linkage to community resources	Cluster-randomized trial recruiting Provider-Supported ($n = 713$) and Patient Self-Directed Care participants ($n = 516$) across 11 provider sites.	Challenges in conducting the trial included intervention training and implementation challenges, participant recruitment and retention, and data collection challenges
Nikolajski et al. 2022 (104)	See Kogan et al. 2017 (106)	See Kogan et al. 2017 (106)	65 interviews with 30 staff exploring perceptions of barriers and facilitators to BHH implementation at baseline, and 1 and 2 years following implementation.	Staff turnover, hesitation to change, and competing acute client needs were major barriers to implementation. Agency-wide culture shifts toward wellness, strong leadership support, and integration into daily workflows were critical success factors.
Schuster et al. 2018 (94)	See Kogan et al. 2017 (106)	See Kogan et al. 2017 (106)	See Kogan et al. 2017 (106)	Both approaches increased patient activation in care (more rapid increase for provider supported participants). Health status and engagement in primary and specialty care increased in both groups, with no between-group differences.

ACT, assertive community treatment; BH, behavioral health; BHH, behavioral health home; BMI, body mass index; CAMH, Centre for Addiction and Mental Health; CMHA-D, Canadian Mental Health Association-Durham; CMHC, Community Mental Health Center; CQUIN, Commissioning for Quality and Innovation; DSRIP, Delivery System Reform Incentive Program; ECG, Electrocardiogram; ED, Emergency Department; EHR, Electronic Health Record; ER, Emergency Room; FQHC, Federally Qualified Health Center; GP, General Practitioner; HIP, Health Improvement Profile; HOPES, Helping Older People Experience Success; IT, Information Technology; NHS, National Health Service; NP, Nurse Practitioner; NYS OMH, New York State Office of Mental Health; PBHCI, Primary and Behavioral Health Care Integration; PCARE, Primary Care Access Referral and Evaluation; PRP, Psychiatric Rehabilitation Program; RCL, Reverse Colocation; SAMHSA, Substance Abuse and Mental Health Services Administration; SMI, Severe Mental Illness; TAU, Treatment As Usual.

(6.9% vs. 9.8%, $p = 0.02$). In a more recent RCT, Errichetti et al. (93) demonstrated that intervention group participants had significantly lower systolic blood pressure (adjusted mean difference −3.86, $p = 0.04$) and average Hemoglobin A1C (HbA1c; adjusted mean difference −0.36, $p = 0.001$) compared to controls at 12 months, with no differences found in diastolic blood pressure, body mass index (BMI), or cholesterol. Other RCTs demonstrated that integrated care models can improve processes and quality of care (e.g., screening rates for preventive care) if not health and wellness outcomes (49, 55, 68, 84, 94).

In a quasi-experimental study, Scharf et al. (95) reported that compared to control clinic consumers, PBHCI consumers showed greater mean reductions in total and low-density lipoprotein (LDL) cholesterol (36 mg/dl, $p < 0.01$ and 35 mg/dl $p < 0.001$ respectively), and greater mean increases in high-density lipoprotein (HDL) cholesterol (3 mg/dl, $p < 0.05$), though no significant effects were observed for other health indicators such as BMI and HbA1c.

In a controlled retrospective cohort study, Iturralde et al. (77) showed that participants of a pharmacist-led collaborative care model for adults with SMI, compared to controls, achieved greater glycemic (ARD = 9.3; 95%CI = 5.0–13.7) and lipid screening (ARD = 13.0; 95% CI = 8.1–17.9) and increased EKG evaluations (ARD = 6.8; 95% CI = 2.0–11.5) from pre- to post-enrollment compared to propensity matched control participants.

In other studies, Gilmer et al. (96) found that highly integrated programs, compared to programs with low integration levels, led to greater improvements in physical health status ($p < 0.01$), higher screening rates for blood pressure, cholesterol and blood glucose (all at $p < 0.01$), a decline in the number of patients who were identified with hypertension and an increase among those identified with prediabetes or diabetes (both at $p = 0.01$). Similarly, Johnson et al. (70) found that Behavioral Health Home (BHH) participation, compared to no participation, was associated with 0.29 fewer percentage points for HbA1c ($p < 0.05$) with no changes noted in LDL cholesterol.

Non-controlled studies also reported on the effects of integrating care on common health indicators. A longitudinal cohort study by Pirraglia et al. (97) found that a primary care clinic co-located in a mental health setting for veterans with SMI had significantly improved goal attainment for blood pressure (adjusted odds ratio [AOR] = 2.16; 95% confidence interval [CI], 1.47–3.18), LDL cholesterol (AOR = 1.60; 95% CI, 1.10–2.34), triglyceride (AOR = 1.64;95% CI, 1.06–2.51), and BMI (AOR = 1.81; 95% CI, 1.29–2.54), though changes in HDL cholesterol and HbA1c were not significant. In a pre-post retrospective chart review, Chambers et al. (69) reported a decrease in the percentage of participants with a blood pressure over ≥120/80 mmHg (27.4% vs. 20.0%, $p < 0.05$) and ≥200 mg/dl total cholesterol (12.0% vs. 8.3%, $p < 0.05$) between 2015 and 2019, though worsened outcomes were observed in waist circumference during the same period.

Health service use outcomes

Eleven studies reported on healthcare utilization outcomes, with select findings described below (see Table 2 for study details). Integrating physical health care into mental health settings was found to have generally positive impacts on healthcare utilization. Primary care and general medical outpatient care access showed improvements in most studies, while emergency and inpatient service use demonstrated promising but not uniformly positive results.

Johnson et al. (70) reported that BHH enrollees experienced an immediate increase in primary care visits, with 0.18 more visits per month compared to non-BHH participants ($p < 0.01$). They also reported an increase in general medical outpatient visits per month compared to non-BHH participants (+0.055, $p < 0.01$). Similarly, Krupski et al. (85) reported that a higher proportion of PBHCI program enrollees in Washington State used outpatient medical services at two sites following program enrollment, compared to propensity matched controls from the same sites. Specifically, the percentage of PBHCI enrollees using outpatient medical services increased from 80% to 92% in site 1, and from 39% to 76% in site 2, compared to limited changes in the control groups ($p < 0.003$ and $p < 0.001$ respectively). In contrast, Breslau, Leckman-Westin, Yu, et al. (98), in a quasi-experimental study using administrative health data observed no differences on the odds of having an outpatient medical visit between PBHCI enrollees and control participants in New York State. Similarly, Iturralde et al. (77) found no differences in primary care visits between participants of a pharmacist led collaborative care model and control participants in northern California.

In non-controlled studies, Pirraglia et al. (97) reported that enrollment in a collocated primary care clinic was associated with a significant increase in primary care visits among veterans with SMI and poor primary care engagement, with the median number of visits increasing from 0 to 2 post-implementation ($p < 0.001$). More recently, Zatloff et al. (98), using a pre-post retrospective chart review, reported significant improvements in the percentage of primary care appointments attended over a one-year period after integrating primary care services within an outpatient behavioral health clinic [$t(136) = 14.50$, $p < 0.001$].

Emergency department (ED) use and hospitalization patterns revealed more complex outcomes across studies. Bartels et al. (68), in a randomized controlled trial, found no change in acute service use at the three-year follow-up of a preventive healthcare intervention for older adults with SMI. Breslau, Leckman-Westin, Han, et al. (99), using Medicaid claims data, found that hospital stays for medical conditions increased significantly in PBHCI clinics in New York City compared to control clinics, possibly due to these programs uncovering previously unidentified physical health needs. The relative odds of hospitalization for a medical diagnosis in PBHCI vs. control clinics was 1.21 (95% CI: 1.10–1.32) in wave 1 and 1.33 (95% CI: 1.07–1.65) in wave 2 of PBHCI grant implementation. Furthermore, there was no significant association between PBHCI enrollment and the likelihood of having an ED visit with a medical diagnosis.

In another PBHCI study, Krupski et al. (85) found that program enrollment was associated with a reduction in the proportion of enrollees with inpatient admissions (from 18% to 12%) at one of two sites, compared to propensity-matched control participants (a reduction from 15% to 17%; $p < 0.04$) but had no significant impact on emergency department use at either site. Using Medicaid claims data from three States, Breslau et al. (100) found that PBHCI program implementation was associated with a reduction in the proportion of enrollees having four or more ED or inpatient visits compared to control clinics, with statistically significant decreases observed in three of the five PBCHI cohorts examined. The reduction in frequent utilization was specific to health service utilization for physical health conditions.

Bandara et al. (101) on the other hand reported that Maryland's BHH program was associated with a reduction in the odds of having an all-cause ED visit compared to non-enrollment (OR:0.87, $p < 0.01$), though there was no effect on inpatient admission rates per person in a three-month period. The reduction in ED utilization was driven by a reduction in the predicted probability (PP) of having a physical health ED visit in a 3-month period among BHH enrollees (PP: 0.21 BHH enrollment vs. 0.24 non-enrollment, $p < 0.01$). Similarly Tepper et al. (91) reported that the total number of ED visits per capita decreased significantly among BHH enrollees compared with control participants ($p = 0.014$). Total psychiatric hospitalizations per capita similarly declined for BHH patients in that study, but remained stable for control group participants ($p = 0.002$). There were no differences in either the rate or the number of general medical hospitalizations. Furthermore, Johnson et al. (70) reported that relative to control group participants, BHH enrollees had an immediate decrease in emergency department visits (−0.031 visits/month, $p < 0.01$). They also reported that while inpatient visits decreased over time for both BHH enrollees and control participants before BHH implementation, they decreased more slowly for BHH patients post-implementation. More recently, Iturralde et al. (77) found no significant differences in ED use and hospitalizations between participants of a pharmacist led collaborative care model for adults with SMI and control participants. Lastly, Goh et al. (75), in a retrospective file audit, analyzed admissions to assess medical comorbidities and interventions, finding that adding a medical resident to an inpatient psychogeriatric unit did not affect emergency medical transfer rates.

Barriers and facilitators of implementation

Seventeen studies discussed barriers and facilitators to implementing integrated care initiatives in mental health settings. Multidisciplinary teams, care coordination, administrative support and organizational cultures emphasizing shared responsibility and collaboration were found to facilitate implementation (47, 82, 90, 102). Furthermore, improved organizational communication and patient engagement were associated with enhanced participant outcomes (102, 103).

Finally, effective teamwork, characterized by clearly defined roles and responsibilities among team members, attention to daily workflows, and connection to community programs were found to be crucial for effective collaboration among providers (79, 82, 88, 89, 104). A clear vision emphasizing integration of physical and mental health care in the organization's mission, and leveraging data systems, were also highlighted as essential, along with strong leadership, aligning efforts and resources (79, 86, 102).

The most frequently identified challenges of implementation include securing adequate financial resources, usability and maintenance of clinical information systems, population health management capacity, lack of care coordination, staff retention, and patient enrollment (47, 79, 81, 82, 89, 90, 103–109). Time-limited funding was identified as an ongoing challenge across different settings (79, 81).

McGinty et al. (108), Daumit et al. (47) and Stone et al. (82) reported that Medicaid Behavioral Health Homes (BHH) in Maryland faced tensions between population health management and direct clinical care, and implementation barriers related to limited staff experience, health information technology usability, difficulty engaging external service providers and state regulations impacting service delivery. Workforce limitations, such as high client-to-staff ratios and frequent staff turnover, further complicated care delivery (47, 82).

Scharf et al. (89) highlighted that across 3 integrated care initiatives in New York State, implementation barriers included licensing requirements, information sharing between providers, infrastructure, and sustainability challenges. In other settings, payment structures and low wages for community mental health work were noted to exacerbate staff retention issues (102, 107).

Engaging primary care providers (PCPs) remained a significant challenge in several settings. Negative attitudes toward patients with SMI and limited incentives contributed to low PCP participation in care coordination (47, 107).

Despite these challenges, programs like PBHCI, and Maryland's BHH demonstrated that with robust funding, strong leadership, and effective communication strategies, integrated care models could reduce costs and improve outcomes when tailored to local needs and supported by multi- disciplinary collaboration (89, 100).

Costs and financing

Six studies explored the costs and savings associated with integrating care in behavioral health settings, focusing on funding and reimbursement strategies, cost-savings and sustainability.

In the initiatives examined, funding was allocated through various mechanisms. Ramanuj et al. (79) reported that the PBHCI program, administered by the Substance Abuse and Mental Health Services Administration (SAMHSA), provided $400,000 per year for four years to enable behavioral health clinics to offer primary care services. The program, initiated in 2009, had awarded 189 grants by 2015, with an average of 250 enrollees per grantee. In 2010, in complementary efforts, the New York State Office of Mental Health introduced regulations designed to promote physical health care in mental health clinics by allowing partial reimbursement for health monitoring and health physicals through Medicaid, although insufficient reimbursement for high-cost services hindered adoption (78).

The same year, the Affordable Care Act Medicaid health home waiver allowed states to create Medicaid health homes, including behavioral health homes, to provide care coordination and health promotion services for beneficiaries with complex health needs (101). Regarding sustainability, the temporary nature of PBHCI grants was a noted barrier, as clinics struggled with fragmented funding. Ramanuj et al. (79) further concluded that sustaining integration efforts required investments in infrastructure, such as electronic health records and care quality monitoring.

Integrated care models achieved variable outcomes in terms of cost savings. An assessment of a medical care management intervention in community mental health settings serving adults with SMI found a $932 reduction per patient in total costs by the second year of the intervention, with a 92.3% probability of being associated with lower costs than usual care [95% CI (−1973, 102)] (48). The study also highlighted that community mental health centers would need at least 58% of their patients to have Medicaid or other insurance for the program to break even financially. Since only 40.5% of enrollees had Medicaid at the study site, the program appeared unsustainable in the long term (48).

Krupski et al. (85) comparing PBHCI clients with propensity matched controls at 2 sites, found that PBHCI participation was associated with a trend toward reduced inpatient hospital costs per participant per month at one site (–$217.68, $p = .06$), although no hospital-related cost savings were observed at a second site. Breslau et al. (101), evaluating PBHCI outcomes across three states, found that PBHCI participation was associated with a reduction in the total costs of care per consumer in three of the five cohorts examined, and no significant cost differences in the remaining two cohorts, compared to control sites. Further, sources of cost reduction varied across cohorts: outpatient costs decreased in two cohorts, while emergency department-related costs showed mixed results, increasing in one cohort and decreasing in another.

Connor et al. (78) examined the financial impact of providing physical health monitoring or physical health monitoring plus health physicals for adults with SMI in specialty mental health clinics in New York State, highlighting significant cost barriers. Health physicals were estimated to cost $153 on average but were reimbursed at lower Medicaid rates ($89.48–$129.28). Similarly, health monitoring sessions cost $51, while reimbursements ranged from $33.79 to $48.82. Additional costs for care coordination, such as referrals and follow-ups, strained clinic budgets, especially for freestanding facilities. The authors highlighted these gaps as barriers to sustainability and widespread adoption and called for policies to address them.

Discussion

With a growing interest in addressing the mortality gap among adults living with SMI internationally, a variety of policy initiatives and integrated care models have been described in the literature in recent years. This scoping review sought to examine integrated service delivery models and clinical practices within mental health settings serving adults with SMI and their outcomes, aiming to capture service delivery and practice innovations in this important area.

Most integrated service delivery models and clinical practices described in this review were implemented in community mental health settings in the United States. The service delivery models examined, although often not described in detail, typically involved collocated or integrated primary care professionals, and generally leveraged several components of Wagner's Chronic Care Model, emphasizing delivery system redesign, patient self-management support, and use of clinical information systems. Funding and leadership support, effective teamwork, care coordination, and leveraging data systems were central to implementation efforts (79, 89, 102). Several implementation challenges were highlighted by stakeholders. These included reimbursement mechanisms, high staff turnover rates, difficulties in engaging primary care providers to treat people with SMI, and communication and coordination between team members (47, 78). Furthermore, challenges with poor health information system usability, were common (108). Overall, integrated care models were noted to require investments in comprehensive workforce training, continuous improvement of clinical information systems, and sustained implementation support. Longitudinal evaluation and dynamic adaptation of these models, informed by implementation science tools, such as the Consolidated Framework for Implementation Research, will be helpful to ensure they meet the evolving needs of both patients and healthcare providers (110).

Physical health indicator and healthcare utilization outcomes showed promising results. Inconsistent improvements across health outcomes are not uncommon in the early stages of implementing service delivery changes (95), and program implementation challenges and limited patient engagement may have reduced program effectiveness in some studies. Although some of the mixed outcomes may reflect the need for service improvements (111), managing complex conditions such as diabetes and obesity necessitates both medical interventions and significant behavioral changes, which can be more challenging to achieve and sustain and generally require longer-term follow up to see improvements (112, 113). Notably, significant improvements were observed in cholesterol and blood pressure in some programs (69, 89, 95–97). As approximately 44% of the decrease of death from coronary heart disease in the general population has been attributed to changes in risk factors, including reductions in total cholesterol and systolic blood pressure (114), these improvements underscore the achievements of the integrated care models, and their potential to improve health outcomes and life expectancy in this population.

While most integrated care models increased primary care visits, there were inconsistent impacts on emergency department visits and hospitalizations, highlighting that additional attention is needed to the complex care needs of this population (70, 85, 98, 99). On the other hand, the observed increases in medical hospitalizations in some programs, particularly during early implementation, may represent a positive outcome by identifying and addressing previously unmet medical needs in this historically underserved population. This understanding emphasizes the importance of considering the complex pathway to improving physical health outcomes among adults living with SMI, and the need for tailored person-centered interventions. Short-term follow-up times may also contribute to the lack of integrated care impact on general medical inpatient utilization, as intervention components may require longer timelines to effect positive change (91).

Strengths of this review include the use of rigorous methods and the assistance of a health librarian. Furthermore, the review examined service delivery models and clinical practices that addressed health needs comprehensively rather than focusing on a single disease or on individual risk factors. This approach renders findings more relevant for service planning and policy development aimed at improving general health. Finally, the review was enriched by input from a diverse study team, inclusive of individuals living with SMI and family members, health services researchers, and clinicians serving this population. The inclusion of these varied perspectives guided our efforts to ensure our work, including our research questions and synthesis and interpretation of key findings, is relevant to key stakeholders. As this scoping review focuses on the breadth of research rather than the quality, it does not include a quality assessment of the included articles. The heterogeneity of the interventions further complicates this issue, making it difficult to apply a standardized quality assessment across all sources. Further, the vast differences in health system structures, organization and funding models across countries and jurisdictions highlights the need for caution in interpreting findings, as interventions that are successful, feasible and acceptable in one context may not be applicable or necessarily yield the same effectiveness or cost outcomes in another. Finally, this scoping review was limited to the academic literature published since 2010, potentially missing models of care or practices captured in the grey literature or earlier academic publications. To address the mortality gap among adults living with SMI, health systems and policy makers need to address all contributing factors, beyond healthcare delivery, including substance use, medication side effects and the social determinants of health affecting this population. Despite its limitations, this review offers important insights into opportunities to advance integrated physical and mental health care delivery for people with SMI within diverse mental health settings, setting the stage for more comprehensive policy interventions.

Future research should continue to examine the effectiveness of integrated care interventions over longer periods of time, to assess long term effectiveness. Further, future studies should offer more detailed program descriptions and include measures of engagement among adults with SMI, as current service delivery models continue to present barriers to engagement (115). This understanding will allow for the refinement and dynamic adaptation of service innovations, and improve their acceptability to service users. There is a notable gap in the literature on aging with SMI. While our review included studies on older adults, the limited research available highlights the need for further exploration in this area, given the challenges of cognitive comorbidities and accelerated aging in this population (116, 117). Finally, no studies addressed the physical health needs of long-term psychiatric inpatients, such as forensic inpatients, which may be difficult to address outside of general hospital settings. These long-term inpatient psychiatric care models require attention to improve the quality and comprehensiveness of care and reduce rates of emergency medical transfers to general hospital settings (75).

In conclusion, this scoping review examined service delivery models and clinical practices aimed at integrating physical health care within mental health settings for adults living with SMI. Although studies of integrated care models demonstrated improvements in some physical health indicators and aspects of health care utilization, further efforts are needed to achieve sustained improvements in a range of health domains and ultimately, reduce health disparities in this population. These findings underscore the necessity of ongoing efforts to address the health needs of this population comprehensively and of evaluating the effectiveness of these interventions over time.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Author contributions

MA: Data curation, Writing – original draft, Writing – review & editing. SZ: Data curation, Formal analysis, Methodology, Validation, Writing – original draft, Writing – review & editing. OM: Writing – review & editing. CC: Conceptualization, Formal analysis, Methodology, Supervision, Writing – review & editing. BL: Conceptualization, Formal analysis, Methodology, Writing – review & editing. SA: Writing – review & editing. AB: Writing – review & editing. MD: Writing – review & editing. Mv: Writing – review & editing. BK: Writing – review & editing. SS: Writing – review & editing. TR: Methodology, Writing – review & editing. TT: Writing – review & editing. CW: Writing – review & editing. VS: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frhs.2025.1570100/full#supplementary-material

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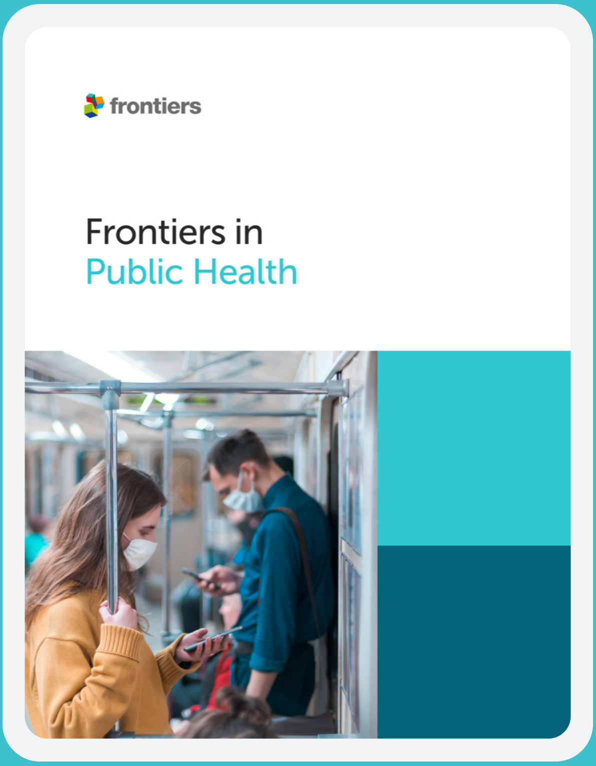

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