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Waste management within the scope of environmental public awareness based on cross-sectional survey and social interviews

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Since the natural resources of the world are not unlimited, the effective use of resources and the access of future generations to these resources concern all societies on a global scale. From this point of view, waste management strategies should be examined in terms of medical, household, and other waste types. Thereby, this study aims to examine the level of public awareness in waste management by studying the perception, perspective, practice about waste's aspects. The survey in this study mentions questions on waste management knowledge, public awareness, and behaviors among social interviews of pharmacy students receiving laboratory training in the field of health. Internal consistency reliability is used to verify the uniformity of questions in this study. Pearson correlation, *t*-test, and the analysis of variance (ANOVA) are performed to study the differences between groups. The results of the data analysis show that public awareness and waste management knowledge, public awareness, and behaviors have a significant positive correlation, which provides us with a good basis for designing environmental strategies. The first module's outcomes of the questionnaire reveal a high degree of waste management among students. On the contrary, woman participants demonstrate a higher public awareness and application of the environment. Furthermore, there are significant correlations between the other modules and demographic factors with family education. According to the results, the public awareness of the participants who were members of an environmental organization is different from others. Finally, the participants state that the problem of not managing wastes effectively causes the most damage to the soil and all other natural resources after water.

KEYWORDS

public awareness, environmental citizenship, sustainability, waste management, social interviews, cross-sectional survey

1 Introduction

The COVID-19 pandemic has shown that many effects can easily occur, with direct and indirect effects on the sensitivity of human nature. It has emerged that medical waste management should be known not only by health professionals but also by all segments of society (Orazbayev et al., 2019; Ma et al., 2020; Zhumadillayeva et al., 2020). The scarcity of natural resources has begun to put pressure on the environmental sustainability of the world (Ince, 2018a). Short-term solutions like selling waste to underdeveloped countries or dumping it into the oceans are no longer acceptable. Because nature has started to show that it cannot handle the waste load with various disasters and results such as the depletion of clean water resources or the inefficiency of the soil (Ince, 2018b; Ingold et al., 2019). Waste management, which requires being a part of global businesses, states, and society, that is, a holistic perspective is starting from the design phase of any product. It is a discipline that covers the production, consumption, waste generation, recycling, and disposal of waste (Margallo et al., 2019).

Waste Management is an approach of management that includes reducing waste at its source, sorting according to its characteristics, collection, temporary storage, intermediate storage, recycling, transportation, disposal and post-disposal control, and similar processes (Minelgaitė and Liobikienė, 2019; Debrah et al., 2021). Today, where technological developments such as Industry 4.0, which consists of various stages such as the internet of things, internet services, and cyber-physical systems, are discussed, there are mobile and robotic systems developed for waste management (Singh et al., 2022). In the literature on waste management, it is seen that the issue is handled with various aspects in terms of different sectors (Chioatto and Sospiro, 2022; Koul et al., 2022; Ławińska et al., 2022). Studies that reveal the importance of education in waste management emphasize concepts such as environmental sensitivity and public awareness and make suggestions to increase it (Stojic and Salhofer, 2022; Owojori et al., 2022; Fan et al., 2021; Xiong et al., 2020; Liu et al., 2020; Tu et al., 2020; Yue et al., 2020; Bao et al., 2020).

Environmental public awareness is a consciousness around the natural environment and the choices that either promote its well-being or cause it more harm. It is also the public awareness that the Earth needs protection for its survival (Severo et al., 2021). The term, meaning knowledge of the natural environment and an understanding of how actions affect local and global well-being, can be greatly enhanced by education (Li, 2018). As a result of public awareness, environmental citizenship is formed by transferring this public awareness into practice. To become an environmental or ecological citizen, first of all, it is necessary to be literate. The first step of environmental literacy is public awareness, and then it is necessary to use this public awareness to solve problems for nature and to implement these solutions (Asilsoy and Oktay, 2018). So the starting point, public awareness, is just as crucial as the results. Cucu Cahyana et al. (2019) have addressed two key variables of environmental citizenship, emphasizing the important role of educators in raising public awareness:

- Major variables: Environmental sensitivity, investment, knowledge, and skill in environmental strategies.
- Minor variables: Knowledge of ecology, attitudes toward pollution, technology, and economies.

There are studies in the literature that action-oriented environmental education can increase environmental citizenship (Green et al., 2016). These research studies on the reflection of individual attitudes on behaviors show that if public awareness is raised through education, it can have a positive impact on environmental behavior and subsequently citizenship (Cobanoglu et al., 2021; Monte and Reis, 2021). The effect rate of public awareness on environmental outcomes can sometimes be lower than expected (Ince, 2014). Hence, models that explain the complex relationship between human behavior and the environment are also emphasized (Akintunde, 2017; Yue et al., 2021).

From this point of view, waste management is discussed in terms of environmental public awareness and citizenship in this study. The importance of the subject stems from the fact that it deals with the environment from different perspectives. Thus, it is aimed to show the relationship between attitudes towards the environment and expected behaviors. As the target population, students from a state university located in the Mediterranean region are selected (Figure 1) and it is limited to the department of pharmacy in the field of health since it is an applied education such as laboratory use. Thereby, it is requested to measure the public awareness, knowledge, and application levels of environmental variables, both medically and daily. Finally, the study offers the opportunity to analyze the current situation in waste management and environmental public awareness, both as a citizen and as a future health professional.

In the social media posts that raise awareness about Turkiye's climate agenda this year, the roadmap to reach the 2053 net zero emission target, especially within the scope of the Paris climate agreement, is mentioned. In addition to social media, the legal outputs of the steps that are planned to be announced to large masses through online conferences are also on the agenda. It is stated that in order to reach net zero emissions by 2053, besides all legal processes, efforts will be made to disseminate social impacts (Aliabadi et al., 2022). The attitude of the country, which is considered in terms of the sample, towards carbon emissions and the way it handles technological developments in this respect are also important as it has the power to affect the social perspective. In 2022, it is seen that there is an increase in scientific studies that

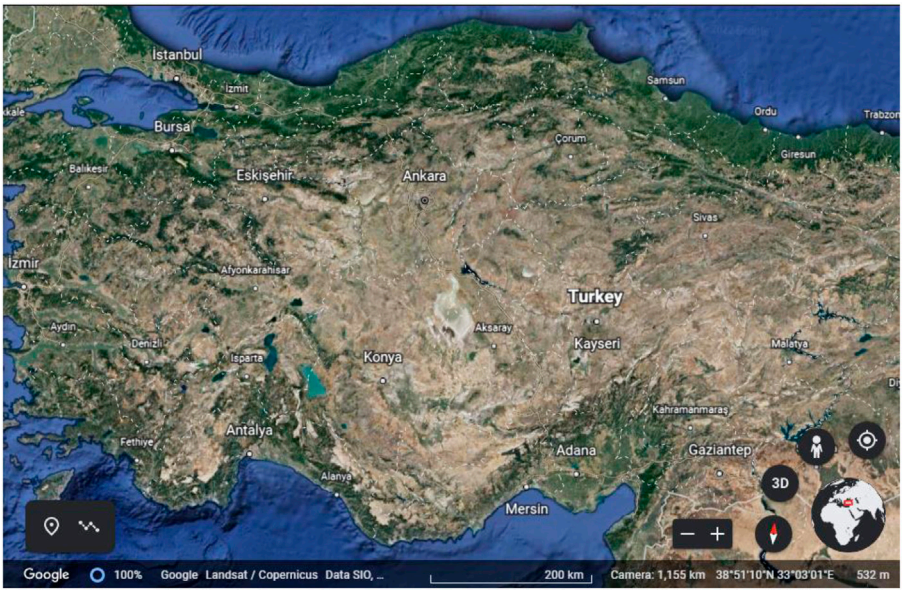

FIGURE 1
Geographic location of the study area in the Mediterranean region of southern Turkiye.

include model proposals on technology-oriented net zero carbon emissions. Cansiz et al. (2022) develop some prediction models for CO_2 emissions in the transportation sector. And according to their study, Artificial neural networks (ANN) give the best performance among simple membership functions and fuzzy rule generation technique (SMRGT), adaptive neuro-fuzzy inference system (ANFIS) methods, support vector machine (SVM), and multiple linear regression (MLR).

In another study focusing on combating regional climate change, these results are obtained in a study conducted in a single province. According to Kerem (2022), "while generating electricity with renewable energy sources, it has been determined that an average of 3,500,794 tons CO2, 3,024,120 tons CO_2, and 1,073,039 tons CO_2 carbon footprint savings were accomplished for 2019, 2020, and 2021". Such studies contribute to promoting research on renewable energy investments for local governments and investors in accordance with the Kyoto Protocols and the Paris Agreement. It also supports regional efforts to combat climate change. On the other hand, in Baş, (2022), building footprint extraction is carried out by a combination of high-accuracy Regularize Digital Topographic Map (RDTM) with LiDAR data in the urban areas to reveal the efficiency of orthophoto in building detection using the ANN method. Therefore, the reflections of technological developments on climate, environment, and waste management should be addressed from a social perspective. So, this study also draws attention to its sociological aspect.

FIGURE 2
Research model for the study.

2 Article types

The purpose of this study is to examine the level of pharmacy students' public awareness in waste management *via* the study of the perception, perspective, practice about many environment's aspects. A study sample (n:336) involving pharmacy students at a state university is evaluated. From January 2022 to March 2022, a cross-sectional survey is undertaken to collect data for the current research model (Figure 2). The survey has included questions on waste management knowledge, public awareness, and behaviors among pharmacy students receiving laboratory training in the field of health. However, the amount of medical and hazardous waste usage in this area is quite limited compared

to other health areas. For this reason, waste management public awareness is also measured in terms of environmental citizenship. In the selected sample, interviews are performed, and a survey is conducted to examine the degree of public awareness, knowledge, and implementation of waste management and environmental citizenship amongst students. Responses from participants are collected using a carefully designed survey of closed-ended questions. Some studies have confirmed that awareness is an antecedent of the behaviour in question. That is, the formation of environmental awareness is an antecedent of environmental behaviour. Therefore, in this study, we focus on the correlation between environmental awareness and waste management.

Although the survey includes three scales, it consists of five parts. Scales, the first of which are waste management (Hacısalihoğlu, 2021), the second is environmental citizenship (WWF, 2008), and the third is environmental public awareness (Çetin and Yalçınkaya, 2018), have been previously developed and used in different studies (Nadeson and Barton, 2014; Yalçınkaya and Çetin, 2018; Çai et al., 2021). The model of the study can be seen in Figure 2.

The main hypothesis of the research is that there is a positive relationship between the modules which includes environmental variables and waste management. Then, as sub-hypotheses, it is examined whether there is a difference in the level of environmental variables in terms of demographic factors. To test the model, the questionnaire is tried to be comprehensive. The information about different variables have been included in the survey such as age, gender, family education level, childhood residence, and other details about waste handling, public awareness, knowledge, and implementation. The data collection tools are prepared in Turkish. Because the medical waste has become a major source of environmental pollution (e.g. disposable testing kits used for nucleic acid testing, etc.), especially since the COVID-19 pandemic, and then many lay people do not have the environmental awareness and expertise in this area (medical waste disposal). Therefore, considering that the people who are most exposed to medical waste in real life would be the group of people engaged in this profession of doctors, pharmacy students were chosen as the subjects for the study. The total number of students who voluntarily participated in the sampling to fill out the survey is 336 (134 males and 202 females, with an average age of 22.4 years). Participants in the study are guaranteed their anonymity and confidentiality. The survey is subdivided into three modules to collect information on various environment's areas. The first module is created to determine the level of waste management among students (Table 1). In addition, environmental citizenship is focused on the second module, which examined ecological implementation. Lastly, the third module has addressed environmental public awareness. In the second and third modules, the responses are classified as positive and negative to compare the variables (Dell-Kuster et al., 2014). For the second module, responses are given four different levels and divided into two levels of positive responses (often and always) and two levels of negative responses (never and rarely) (Figure 3). On the other hand, for the third module, responses are given in five different levels and divided into three levels of negative responses (strongly disagree, disagree, and neutral) and two levels of positive responses (agree and strongly agree) (Figure 4). Positive responses suggest that the participant has a high level of

TABLE 1 Frequency and percentage table of demographic factors.

Variable	Group	Frequency	Percent (%)
Gender	Female	202	60.1
	Male	134	39.9
Mother's/Father's education	Primary	200/133	59.5/39.6
	High school	90/115	26.8/34.2
	University	46/88	13.7/26.2
Childhood residence	Rural	54	16.1
	Urban	219	65.2
	Both	63	18.7
Total		336	100

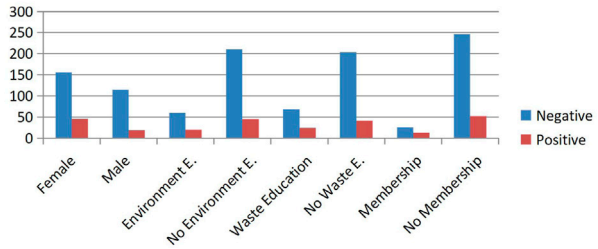

FIGURE 3
Module two additive sums of positive and negative answers.

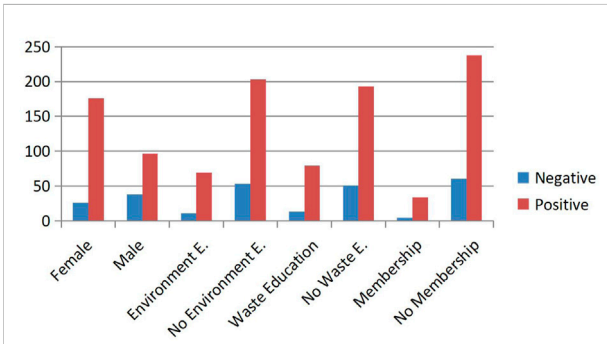

FIGURE 4
Module two additive sums of positive and negative answers.

knowledge and application of the subject of this topic, while negative responses indicate the reverse.

3 Data collection and analysis methods

Data from cross-sectional surveys conducted *via* social interviews at selected samples have been entered to evaluate the data acquired for item analysis, reliability, and validity of the produced instrument. In this study, we used SPSS 2.7 as the data analysis tool (McCrum-Gardner, 2008). Data characteristics were analysed through descriptive statistics; the relationship between the three main variables was verified through Pearson's analysis; and differences between sample groups were explored through analysis of variance. Descriptive statistics are employed to calculate frequency, percentage, average, and variance for study participants' demographic characteristics (Fisher and Marshall, 2009). The study's findings are shown in the form of figures, tables, and texts as needed. Internal consistency reliability (Cronbach's alpha coefficient) is used to verify the uniformity of questions in this study (Taber, 2017). Pearson correlation, *t*-test, and the analysis of variance (ANOVA) are performed to study the differences between groups (McCrum-Gardner, 2008).

4 Result of data analysis

The scales are valid since the reliability statistics of the items used in the survey are obtained above the statistically accepted level ($\alpha > 0.70$). The reliability statistics for each of the three modules and on the overall questionnaire are discussed as valid according to the levels of Cronbach's alpha coefficient. The first module's level of Cronbach's alpha coefficient is 0.797 while the second one is 0.797, and lastly, the third one is 0.877. Additionally, Cronbach's alpha coefficient level of the whole items is 0.895. Further, the analysis showed that removing any of the items would not significantly increase the alpha levels. According to George and Mallery (2010), "A kurtosis value between ±1.0 is considered excellent for most psychometric purposes, but a value between ±2.0 is in many cases also acceptable, depending on the particular application." Skewness is 0.259 (0.133) and kurtosis: 0.190 (0.265) for environmental citizenship, while skewness is -1,075 (0.133) for environmental public awareness, and lastly skewness is 0.565 (0.133) and kurtosis 0.320 (0.265) for waste management. Thus, it can be said that the data of the study refer to a particular statistical distribution named the normal distribution, which is symmetric continuous distribution defined by the mean and standard deviation of the data. According to Hair et al. (2018) "skewness measure of the symmetry of distribution; in most instances, the comparison is made to a normal distribution. A positively skewed distribution has relatively few large values and tails off to the right, and a negatively skewed distribution has relatively few small values and tails off to the left. Skewness values falling outside the range of −1 to +1 indicate a substantially skewed distribution."

Participants are asked where they spent their childhood to understand their perspective on the environment. This question is aimed to determine whether there is a difference between the perspective of an individual who grew up in a village and a city. The education level of the mother or father is also among the demographic factors that cause attitude differences in some studies (Pe'er et al., 2007; Oktaviani, 2017). However, the gender factor appears to be quite decisive in this sample. According to the general distribution in Table 1, the majority of the participants are women (60%) and grew up in the city (65%).

The questions measuring the attitudes, knowledge, and behaviors of the participants towards waste management, who were asked to choose one of four answers as yes, sometimes,no, total, are shown in Table 2. Responses to questions measuring recycling knowledge include a low yes rate and a high yes rate for water and electricity savings (74%). In the social interviews and some open-ended questions, the participants state that due to the high cost of living in the post-pandemic period, paying attention to expenditures is also effective in this saving trend. It is an accepted method in the evaluation of dishes with increased sensitivity to stray animals (67%). The campus environment, which includes small shelters for cats and dogs and allows them to roam freely in common areas, can also contribute to this trend.

The first module aims to find the level of knowledge and public awareness in waste management among participants. The second module is about environmental citizenship, and Figure 3 depicts the survey findings of several categories according to this module. The positive and additive negative responses are summarized in this bar graph. Different categories represent different replies to the questions such as gender, participation in environmental education, participation in a waste management project or education, and membership in an environmental organization. According to the positive response of environmental citizenship:

- Female has a higher positive rate than male (0.29 > 0.16).
- Participants who get educated about the environment have a higher positive rate than uneducated ones (0.33 > 0.21).
- Participants who get educated or volunteer about waste management have a higher positive rate than non-volunteers (0.35 > 0.17).
- Environmental organization members have a higher positive rate than non-members (0.52 > 0.21).

Environmental organization members have the highest value with a positive rate of 0,52 whereas male participants have the lowest positive rate with 0.16. The mean level of the second

TABLE 2 Percentage table of some of the waste management responses.

Questions	Yes	Some	No	Total
Do you know the meaning of the recycling signs on the packaging of the product you buy?	43.2	49.4	7.4	100
Do you throw plastic, glass, metal, and paper into designated recycling bins?	47.3	47.0	5.7	100
Do you pay attention to water consumption when using the bathrooms?	78.3	18.7	3.0	100
Do you unplug electronic devices when not in use?	74.1	20.5	5.4	100
Do you share your leftover food with stray animals?	67.9	27.6	4.5	100

TABLE 3 *t*-test results comparing gender groups on environmental public awareness and citizenship.

Variables	Female		Male				
	M	SD	M	SD	df	t	Sig
Environmental public awareness	4.57	0.54	4.34	0.58	334	3.57	0.000
Environmental citizenship	2.71	0.50	2.56	0.50	334	2.71	0.007

module is 2,65 out of 4, while the first module is 1,93 out of 3. A five-point Likert scale is used to evaluate module 3, the results are highly satisfying, with a mean value of 4.48 (Lange et al., 2020). In addition, Figure 4 depicts the survey findings of several categories according to this module. The positive and additive negative replies are summarized in this bar graph. According to the positive response of environmental public awareness:

- Female has a higher positive rate than male (6.76 > 2.52).
- Participants who get educated about the environment have a higher positive rate than uneducated ones (6.27 > 3.83).
- Participants who get educated or volunteer about waste management have a higher positive rate than non-volunteers (6.07 > 3.78).

Environmental organization members have a higher positive rate than non-members (8.50 > 3.96).

Environmental organization members have the highest value with a positive rate of 8,50 while male participants have the lowest positive rate with 2.52. These percentage rates are calculated as the ratio of positive responses to negative responses in each category. That is, when 176 female participants give positive answers and 26 female participants give negative answers, the positive response rate in the female group is around 6% (6.76).

According to the results of Pearson correlation analysis, there is a positive and significant relationship between the three modules that make up the research model. Although the correlation is low, this means that the main hypothesis of the research is accepted. The correlation coefficient r is 0.265 ($p < 0.001$) between environmental citizenship and environmental public awareness, while it is 0.239 ($p < 0.001$) between environmental citizenship and waste management. In addition, it is determined that environmental citizenship is also correlated with demographic factors as gender 0.147 (p: 0.007), environment education 0.144 (p:0.008), waste management education 0.154 (p:0.005), membership 0.144 (p: 0.009), mother' education 0.144 (p:0.008), and father' education 0.118 (p:0.031).

In the other module, environmental public awareness also has a low level of positive correlation with waste management 0.288 ($p < 0.001$) and other factors as gender 0.192 ($p < 0.001$), waste management education 0.113 and membership 0.113 (p: 0.039). Lastly, waste management has positive correlations with environment education 0.127 (p:0.020), membership 0.143 (p: 0.009), and childhood residence 0.117 (p:0.031).

The independent-samples *t*-test is conducted to compare environmental citizenship in female and male groups. As shown in Table 3 there is a significant difference in the scores for female ($M = 2.7$; SD = 0.5) and male ($M = 2.5$; SD = 0.5) groups; t (334) = 2.71, p:0.007. On the other hand, this significant difference applies to environmental public awareness as well. So, there is a significant difference in the scores for female ($M = 4.5$; SD = 0.5) and male ($M = 4.3$; SD = 0.5) groups; t (334) = 3.57 p:0.000. However, there is no statistically significant difference in waste management in terms of gender groups (F: 0.014; $p > 0.005$). Also, the *t*-test is not significant in terms of environmental education (F:0.304; $p > 0.005$), and participation a waste management project (F:0.130; $p > 0.005$). According to the environmental public awareness module, there is a significant difference in the scores for members ($M = 4.6$; SD = 0.3) and non-members ($M = 4.4$; SD = 0.5) groups; t (334) = 2.07 p:0.004.

TABLE 4 Percentage table of responses about waste bags.

Waste types	Black	Blue	Red	Yellow	Don't know	Total
Household waste	**40.2***	18.5	0.9	7.1	33.3	100
Hazardous waste	17.0	2.1	**34.2**	19.0*	27.7	100
Packaging waste	5.7	36.3*	4.2	11.3	**42.6**	100
Medical waste	8.3	19.3	**35.7***	11.0	25.6	100

Bold values indicates the largest share.

FIGURE 5
Natural resources damage assessment.

Although the difference is small, it is statistically significant, that is, those who are members of any environmental organization have a 0,2 higher mean value in terms of environmental public awareness. This means that the sub-hypotheses of the research are accepted too.

One-way ANOVA test results showed that there is not any statistically significant difference in the effect of mother's and father's education on environmental public awareness, citizenship, and waste management as well as childhood residence (F:0.706; $p > 0.005$). After the difference analyses, the data on the level of knowledge in terms of waste management can be examined in Table 4.

Regarding the level of knowing which bin or bag to put household waste in, 40% of the participants give the correct answer as black, followed by "I do not know" with 33%. The color of the hazardous waste bag is red with 34%, I do not know 27% and the correct answer is yellow with 19%. While the word danger is wrong by connoting the red answer, it may have promoted this answer to first place. In the color of recyclable waste bags such as packaging, medicine, and serum bottles, the answer "I do not know" ranked first with 42%, while the correct answer is blue with 36%. In the question about medical waste, the correct answer is the red waste bag color with 35%.

Finally, it is asked which resource wastes cause the most damage to measure public awareness of the impact of developments that threaten the environment on natural resources. Individuals are given the right to choose more than one source while answering this question (Figure 5). Thus, it can be determined to what extent the pressure on natural resources is felt.

When the responses received are carefully examined, it is noticeable that water scarcity has begun to be experienced as a result of developments such as drought, scarcity of precipitation, and the gradual decrease of clean water resources, and people can observe this scarcity in the current situation. Participants prefer primarily water (28.7), then soil (27.0), air (26.6), and nutrients (17.7) among the most pressing sources of waste. It is also stated as a comment that this pressure exists in all sources and if no precautions are taken, the seas and clean water resources will worsen in the future.

When the results of this study are compared with the studies in the literature, similar results are obtained. According to the study of Ince (2014), although individuals are concerned about the environment, they do not pay attention to this issue in their purchasing behavior. Severo et al. (2021) find a significant difference between gender and environmental public awareness in the country comparison study which they conduct during the pandemic period. Age and gender are strong variables that may differ between groups according to the subject studied (Ince, 2022). Also, the study of Li (2018) in six different departments of Minzu University emphasizes the positive relationship between environmental attitude, public awareness, and education. Lastly, Ahmad et al. (2012) highlight that the environmental issue should be kept on the agenda for public awareness, and action should be taken now in their research consisting of Malay, Chinese and Indian youths between the age of 18–25.

5 Conclusion

This paper aimed to draw attention by considering the issue with different dimensions, which deals with waste management in terms of environmental public awareness. So we can draw the following management conclusions.

Firstly, education, and living by seeing environmental problems can have dramatic effects. Thus, it would be useful to first look at how the research is structured and then interpret the results. The study deals with the subject of environment and waste management in three modules and includes detailed information supporting these models with various questions. . On the other hand, Our research tries to determine the level of

environmental citizenship by measuring behaviors. Lastly, environmental public awareness is measured to understand environmental sensitivity in the third module.

Secondly, demographic factors such as family education level, childhood residence, and gender are also included to understand whether attitudes and behaviors towards the environment differ according to these factor groups. Further, the participants are asked whether they have received any training on the environment or waste management before, whether they are involved in a project on these issues and whether they are members of any environmental organization.

Thridly, The environmental awareness of practitioners needs to be strengthened. We found that there is a need for public awareness-raising training for the target audience and studies to increase sensitivity and desired behaviors on waste management. In addition to regular training, waste projects that combine fun and participation should be more widely.

Forth, Environmental behaviour is closely related to environmental knowledge and environmental citizenship. Although the participants state that they are sensitive to the environment in terms of environmental public awareness, these tendencies are relatively less reflected in behaviors in terms of citizenship and waste management. When the relationship between environmental variables and demographic factors is considered, statistically positive relationships are obtained. The difference analysis shows that female participants and those who are members of any environmental organization have higher environmental public awareness levels.

Fifth, People's educational background, family environment and other factors have a strong influence on their willingness and behaviour to become environmentally friendly. Considering the percentages of positive and negative responses to environmental citizenship and public awareness in the second and third modules, the results are highlighted. Thereby, decision-making authorities should support all social responsibility groups such as leading institutions of the society and voluntary organizations to implement some practices by paving the way for educators. International businesses that affect consumption also have responsibilities in this field. Their new management approaches towards the environment can also serve both future generations and the current society by organizing appropriate training, events, and public relations activities to increase environmental public awareness in the global arena. These competitive and sustainability-oriented businesses can profit in the long run by adopting perspectives that embrace society and nature.

The results show that in addition to planned, continuous and stable training on sustainable environment and waste management, participatory activities, fun activities, and projects should be done especially at early ages. A sustainable environment is a crucial issue that concerns all segments of society, from local to global. Therefore, new research on these issues can guide professionals as well as the literature. If the positive contribution of education and being a member of any environmental organization can change people's behavior, there is still hope for efficient use of resources and transfer them to future generations. So, it is recommended that the leading institutions in this field should be examined and brought to science to set an example for professionals as well as researchers on medical waste public awareness and practices, especially in special periods such as pandemics. Additionally, waste and environmental problems in different sectors such as agriculture, industry, and tourism can be examined, and comparisons can be made between different countries. For nature to continue living on its own, people must be willing to reduce its environmental impacts. Because while nature can live without humans, humans cannot live without nature. The sensitivity of the subject is due to its vital importance.

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

Conceptualization, YZ and JX; methodology, YZ and FI; validation, YZ, JX, HT, and MK; formal analysis, YZ, JX, and X-GY; investigation, YZ, JX, and FI; resources, YZ, JX, HT, and MK; data curation, YZ, JX, and X-GY; writing—original draft preparation, YZ, JX, and X-GY; writing—review and editing, YZ and FI.; supervision, YZ, JX, HT, and MK; project administration, YZ and JX; funding acquisition. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

JX was employed by VIPSHOP (China) Co., Ltd.

The remaining 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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