



KNOWLEDGE AND ATTITUDES TOWARD WASTE MANAGEMENT AMONG SECONDARY SCHOOL STUDENTS IN BAIJI DISTRICT: A CROSS-SECTIONAL STUDY

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ABSTRACT

Improper waste management poses a threat to students' health, particularly in educational environments that do not adhere to safe waste management practices. This study aimed to assess secondary school students' knowledge and attitudes toward waste management in Baiji District. A cross-sectional survey was conducted among secondary school students in Baiji District. The research was carried out over five months, with data collection taking place from November 1, 2025, to March 30, 2026. The total sample size was 427. Data collection relied on a single, self-administered, structured questionnaire designed specifically for this assessment. Both descriptive and inferential statistical methods (Independent t-test, ANOVA, Pearson correlation) were used for data analysis. Regarding level of knowledge, 263 (61.6%) had a low level of knowledge, 150 (35.1%) had a moderate level, and only 14 (3.3%) had a high level of knowledge. Regarding the study participants' attitudes, 305 (71.4%) have positive attitudes, and 122 (28.6%) have neutral attitudes. While statistically significant differences were observed in grade level, a significant correlation was observed between knowledge and attitude ($r = 0.098$, $P = 0.044$). At schools in Baiji, the percentage of students with low knowledge of waste management is relatively high. This requires developing targeted training and awareness programs on proper waste handling provided by educational institutions for this and similar groups to maintain a healthy school environment.

Keywords: Attitudes; Baiji District; Knowledge; Waste management

INTRODUCTION

Globally, waste levels have increased significantly due to rapid population growth, urbanization, and high consumerism, making it one of the most serious environmental problems (Jampala & Shivnani, 2024). The United Nations Environment Programme and the International Solid Waste Association (UNEP and ISWA) indicated that volume of municipal solid waste disposed of worldwide in 2023 is approximately 2.1 billion tons. Only one-third of this amount is managed in an environmentally sound manner. A country's income level influences the amount of waste it generates, and waste production is projected to reach 3.8 billion tons by 2050 (UNEP & ISWA, 2024). In Iraq, the ecosystem is negatively impacted by the production of large volumes of solid waste, which is disposed of unsafely in unregulated landfills due to infrastructure destruction (Al-Mohammed et al., 2021). The Commission of Statistics and Geographic Information Systems (GIS) reports that 61.9% of rural areas and 87.7%

of urban areas receive municipal waste collection services. Two waste-sorting and recycling plants in Iraq recycle approximately 11,495 tons of waste annually. Furthermore, more than 62% of landfill sites had no environmental approvals (Commission of Statistics and GIS, 2025). In the school environment, students are more susceptible to multiple illnesses due to pollution and the spread of disease vectors. The main health problems students may face include infectious diseases, respiratory infections, and cholera, which can increase student absenteeism (WHO & UNICEF, 2022).

Improper waste management poses a threat to students' health, especially in educational environments that do not adhere to hygiene and safe waste management standards. The United Nations Children's Fund and World Health Organization (UNICEF and WHO) indicate that the use of unsafe waste disposal methods in the school environment contributes to the spread of pollution and poses a risk to the health of students and staff, as well as creating poor environmental conditions that

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negatively affect students' academic performance (UNICEF & WHO, 2019). Poor waste management is widespread globally; only 63% of schools have basic sanitation services, and 57% have basic hygiene services (Babiker et al., 2022). There is significant variation in the prevalence of safe waste management practices, with the percentage of schools with waste management systems in developing countries ranging from 10.9% to 62.4% (Babiker et al., 2022).

The causes of poor waste management include environmental challenges, logistical and technological constraints, lack of public participation and awareness, international factors, socioeconomic factors, governance issues, and political, behavioral, and cultural factors (Amasuomo & Baird, 2016). Individuals' knowledge, attitudes, and practices regarding solid waste influence waste management outcomes. Environmental framework strategies can be developed, which contribute to improved public health overall (Nizar et al., 2018). The Theory of Diffusion of Innovations provides a basis for many studies by incorporating innovation across the Knowledge, Attitudes, and Practices stages. This theory is associated with the continuation of environmental education in schools. This education helps raise students' awareness of waste management by developing their knowledge, attitudes, and practices. Behaviors result from the acquisition of specific skills, leading to positive changes in practices (Rogers et al., 2019).

This study aims to guide strategists and developers, and contribute to the creation of interventions that protect student health and reduce poor school waste management. The insights from this research will assist local authorities and the Education Directorate by raising awareness regarding the environmental demands of students. Although some attempts have been made to address this issue, much work remains to be done in this area. To the best of our knowledge, no studies have examined knowledge and attitudes toward waste management among secondary school students in Baiji District, aside from a few studies across Iraq. This gap necessitated doing so in this study. Therefore, this study aims to investigate secondary school students' knowledge and attitudes toward waste management in Baiji District.

RESEARCH METHODS

Study Design

A cross-sectional survey was conducted among secondary school students in Baiji District. A school-based, cross-sectional, descriptive design was used. The study was conducted in public secondary schools in Baiji District, Saladin

Governorate, Iraq. The study was carried out over a period of five months starting from the 1st of November 2025 to the 30th of March 2026.

Population Sample and Instruments

The secondary school-age students in Baiji District were the study's target population. To determine the appropriate sample size (n), the following equation was utilized:

$$n = [z^2 * p * (1-p) / e^2] / [1 + (z^2 * p * (1-p) / e^2 * N)] \text{ (Daniel \& Cross, 2019).}$$

In this context: Z = 1.96 for a confidence level (α) of 95%, p=expected prevalence (50%), N=population size (16113), e=margin of error (0.05).

The total number of students in intermediate and secondary schools in Baiji District was 16113. The calculated sample size was 376. To boost the study's validity and power, the sample size was raised to 450 students, and the final participating sample was 427. All students from the first, second, and third intermediate grades who were attending class, accepted to participate in the study, and provided parental consent. Students who suffer from severe cognitive diseases or who are mentally disabled, students with incomplete answers, and students who do not agree to participate in the study were excluded. For data collection, a multi-stage cluster sampling technique was used.

Stage 1: Selection of Schools; 10 schools were randomly selected from a list of public intermediate and secondary schools.

Stage 2: Selection of Classes; within each selected school, one class from each grade (first, second, and third intermediate grades) was randomly selected.

Stage 3: Selection of Students; 15 students present in the selected classes on the day of data collection were invited to participate, having been chosen using Simple Random Sampling via Lottery.

Variables and Instruments

The instrument's design comprises three sections. The first section collects basic information such as age, gender, grade level. The second section addressed the knowledge assessment, consisting of 15 multiple-choice and true/false questions. The student responder received 1 point for each correct answer and 0 for each incorrect answer. Knowledge was categorized into: High [12-15], Moderate [9-11], and Low [0-8]. The third section assessed attitudes, consisting of 5 Likert-scale items (Strongly Agree to Strongly Disagree). The positive statements were scored as (5 to 1), while negative statements were reverse-scored. Attitudes were categorized into: Positive [3.67 to 5.00], Neutral

[2.34 to 3.66], and Negative [1.00 to 2.33]. The face and content validity of the questionnaire were established qualitatively by a panel of experts. Necessary modifications were implemented to ensure the clarity and relevance of all items. To test the questionnaire's reliability, both stability and internal consistency were evaluated. The stability reliability (test-retest) method was applied using the Pearson Correlation Coefficient, yielding robust coefficients for knowledge ($r = 0.72$) and attitude ($r = 0.94$). The internal consistency of the instrument was assessed using Cronbach's alpha (0.78).

Ethical considerations

This research received formal ethical approval from the Institutional Review Committee at the College of Nursing, University of Kirkuk. Formal approval to conduct the study was obtained from the Education Directorate in Baiji District, and each school principal granted permission for the study to be conducted within their schools. Written consent was obtained from parents who agreed to allow their children to participate. Each student who participated in the research received explicit confirmation that participation was entirely voluntary.

Data analysis

Data analysis and statistical analysis were performed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics Frequencies and percentages were used to describe demographic data. Inferential statistical data analysis: Independent t-test and one-way ANOVA were used. Pearson's correlation coefficient was used. The Shapiro-Wilk test was used to assess normality. alpha value was set at 0.05.

FINDINGS AND DISCUSSION

The study included 427 students, yielding a response rate of 95%. Of these, 248 (58.1%) were male, and 179 (41.9%) were female. The mean $\pm$ SD age of the sample was 14.31 ± 1.37 years. Regarding the grade level, 148 (34.7%) were in the first intermediate grade; 142 (33.3%) were in the second intermediate grade; and 137 (32.1%) were in the third intermediate grade. Of all subjects, 263 (61.6%) had a low level of knowledge, 150 (35.1%) had a moderate level, and only 14 (3.3%) had a high level of knowledge. Regarding the study participants' attitudes, 305 (71.4%) have positive attitudes, and 122 (28.6%) have neutral attitudes, as shown in Table 1 and Figures 1 and 2.

The study found no significant differences in knowledge and attitude scores between age and

gender. While statistically significant differences were observed in grade level, a significant correlation between knowledge and attitude was observed, as shown in Tables 2, 3, and 4.

Table 1. Frequency distribution of the participants' socio-demographic (n=427).

Variables	Age (years)	No (%)
	12	37 (8.7)
	13	87 (20.7)
	14	127 (29.7)
	15	87 (20.4)
	16	64 (15.0)
	17	20 (4.7)
	18	5 (1.2)
Mean $\pm$ SD = 14.31$\pm$1.37		
Gender		
	Male	248 (58.1)
	Female	179 (41.9)
Grade level		
	First intermediate grade	148 (34.7)
	Second intermediate grade	142 (33.3)
	Third intermediate grade	137 (32.1)

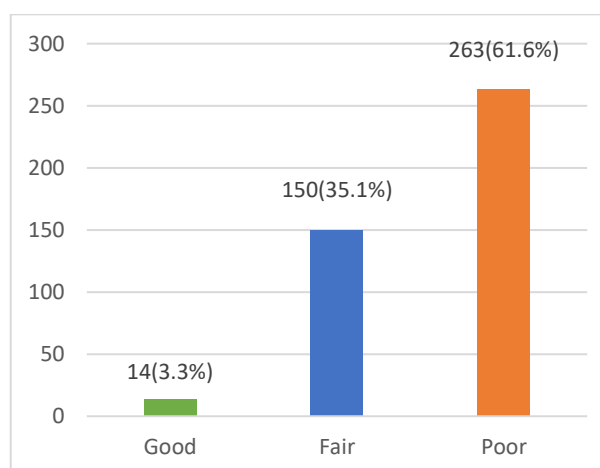


Fig. 1. Overall distribution of Knowledge score for the Study Sample (n = 427)

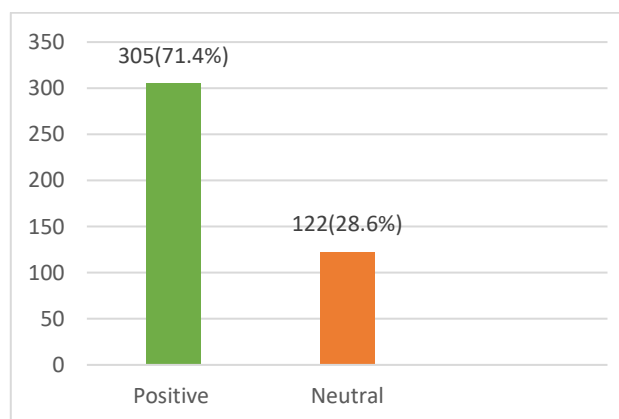


Fig. 2. Overall distribution of Attitude score for the Study Sample (n=427).

Table 2. Relationship linking the students' demographic variables with their knowledge results for the study sample (n=427)

Variables	NO.	Mean SD	Test statistic	P value
Age	427	14.31±1.37	r=0.091	0.061***
Gender				
Male	248	7.85±1.88	t=-0.415	0.678*
Female	179	7.93 ±2.19		
Grade				
First intermediate grade	148	7.95±2.15		
Second intermediate grade	142	7.54±1.95	F=3.582	0.029**
Third intermediate grade	137	8.16±1.9		

*Independent t-test, **One-way ANOVA, ***Pearson Correlation

Table 3. Correlation between knowledge and attitude scores for the study sample (n=427).

Variable	Test statistic	P value
Knowledge vs. attitude	r=0.098	0.044

r =Pearson Correlation

This cross-sectional study aimed to examine levels of knowledge and attitudes toward waste management among students in the study area. The results of the study show that more than half of the students (61.6%) have a low level of knowledge regarding waste management, while (35.1%) have a moderate level, and only (3.3%) have a high level of knowledge. This result is consistent with studies that found that (62.6%) of college students lack an understanding of waste classification (Liu et al., 2024). Educational institutions often encounter difficulties due to a significant lack of knowledge about waste-related hazards. Also, the results of another study show participants' knowledge is very limited and that (95.3%) of participants had poor knowledge of waste management (A'yunin et al., 2022). These figures fall below the benchmarks reported in regional literature, such as a Mogadishu study where 58% of respondents demonstrated adequate understanding (Omar et al., 2019). Conversely, a study found that most students had satisfactory levels of knowledge (73.4%) (Barlao et al., 2016). The discrepancies may partly be due to factors such as the availability of environmental training programs and ongoing awareness campaigns. The study's results show differences in students' knowledge of specific waste management concepts. Most of the students are aware of general risks, with (88.3%) answering correctly that unmanaged waste causes diseases, and (85.9%) knowing that recycling saves natural resources. According to the study's findings, 29% of students correctly answered the first step in waste management, and 26.7% correctly identified the meaning of Reduce, Reuse, and Recycle. Consistent with another study, college students were generally aware of the importance of waste separation and their responsibility for achieving it, but lacked adequate knowledge of how to do so (Qu et al., 2023). Similarly, students had limited knowledge

and practical understanding of waste segregation (Konstantinidou et al., 2024). In addition, another study found a lack of knowledge about safe waste-disposal practices (Mariba et al., 2026). Some possible explanations for the students' lack of knowledge include the scarcity of curricula, programs, and educational seminars. Some students explained that they were not taught information about the environment, and that their information came from social media.

The majority of the students have a positive attitude toward waste management, according to the findings. According to the study's results, 305 (71.4%) of the participants have positive attitudes, and 122 (28.6%) have neutral attitudes. According to the study's findings, 59% of students strongly agreed with throwing waste into dustbins, and 59.3% strongly agreed that proper waste management helps keep the school clean and healthy. This was consistent with the study by Acollador & Ortiz (2026), which found that residents believe in the importance of waste management for environmental protection and that it was the responsibility not only of the government but also of each individual. The outcome was consistent with the findings of Eshete et al. (2023), who reported that 62% of households strongly agreed that solid waste collection and disposal are the responsibility of every household. Additionally, another study reveals that students show a positive attitude (84.9%) (Hassan & Rosli, 2022). In line with the study's findings, a study conducted to determine the impact of attitudes indicates that (71.4%) of students had a satisfactory attitude towards waste management strategies (Barlao et al., 2016). In contrast, a study conducted in Calabar South to assess residents' attitudes found that participants have a negative attitude towards waste management (Eneji et al., 2017). On the other hand, a study in Malaysia found that more than half of the

students (65.9%) had negative attitudes towards SWM (Desa et al., 2012). The difference is due to several factors, including the deterioration of the education sector and the collapse of waste management systems in areas that witnessed war, which negatively affected student attitudes compared to stable regions. On the other hand, the current study's results show that some students lack individual commitment, as 26.5% agree that they do not care if classmates throw garbage anywhere. A further study found that students had low levels of responsibility and an indifferent attitude toward environmental problems (Hamaamin & Abdullah, 2025). This shows a significant discrepancy between students' attitudes toward waste management and their actual practices. A lack of continuous environmental awareness campaigns, insufficient school infrastructure for recycling, and poor integration of environmental topics into the core curriculum could be key factors contributing to this negative attitude. Some students stated that they came to learn, not to clean the school or maintain its cleanliness, as they considered this the responsibility of the cleaning staff. The results of the current study show that 45.9% of students strongly agreed that they feel uncomfortable when they see litter around the school compound. Current results show that 39.1% of students agree that it was important to separate waste materials such as paper, plastic, and food, and 39.6% strongly agree with the willingness to participate in school recycling programs. Additional research shows that 81.4% of students reported that if provided with the necessary materials, they would be willing to recycle their waste (Owojori et al., 2022).

The results of the study show a statistically significant difference between knowledge scores and grade level. This was consistent with studies by Owojori et al. (2022), which found that master's-level students had greater knowledge of waste sorting than students at lower levels. Additionally, a different study reveals that university-level effects on knowledge outcomes regarding waste sorting (Liu et al., 2024). The current study reveals no association between age, gender, and knowledge or attitude scores. This result coincided with another study that found no association between age and waste management (A'yunin et al., 2022). Contrary to other research, one study indicated that knowledge was affected by gender and age (Konstantinidou et al., 2024). The lack of association between gender, age, and knowledge in the current study could be attributed to the unified curriculum and equal access to environmental education provided to all students in the targeted schools. The conflicting findings across studies

might be due to broader demographic samples spanning different generations or to distinct cultural roles assigned to males and females in those communities. The sample's relative homogeneity may explain the absence of significant differences in the current study. Since the students likely share similar geographic and educational environments, variables such as parents' education and family income did not create noticeable gaps in their environmental knowledge. The discrepancies with other research might stem from studies conducted in regions with starker socioeconomic inequalities.

A significant association was found between grade level and attitude scores. This finding was consistent with another study that found that grade affected attitude scores regarding waste classification (Liu et al., 2024). The current study found no association between age, gender, and attitude scores. Consistent with the present evidence, a study found individual attributes, including sex, age, and civil status, were not significantly associated with students' KAP ratings (Barlao et al., 2016). On the other hand, the study found no association between father's education, mother's education, residence, family monthly income, and attitude scores. This discrepancy in results might be explained by the standardized school environment, which fosters a collective mindset among students. When students were exposed to the same school policies and peer influences, individual demographic differences such as gender and age tended to have less impact on their overall attitudes than in broader societal settings.

The current study shows a statistically significant positive correlation but weak correlation between knowledge and attitude scores towards waste management. These findings were consistent with another study that found a weak association between knowledge and attitude (Thirunavukkarasu et al., 2022). Additionally, another study reports a moderate positive correlation between knowledge and attitude (Tolera et al., 2022). In contrast, another study reveals that knowledge of SWM was inconsistent with attitudes toward SWM (Desa et al., 2012). According to another study, knowledge alone was insufficient to improve attitudes toward waste management (Garg & Mishra, 2026). In addition, having theoretical knowledge about solid waste management does not necessarily translate into a positive attitude without the presence of environmental awareness programs and community involvement. It is recommended that educational institutions provide extensive training and awareness programs on the proper handling of waste provided by educational institutions to

promote environmental protection, which are essential to keep the school environment healthy, it is crucial to understand the management of waste and adhere to school rules concerning waste segregation, and do further studies in the future, including determining the variables linked to the behavioral gap between knowledge, attitudes, and actual practices in Baiji schools generally and with large sample sizes.

One of the study's limitations is that the localized scope of the sample prevents the direct application of findings to the entire student population across Baiji District. Due to the cross-sectional design of this investigation, confirming a direct cause-and-effect link between the independent variables (factors) and the outcomes (waste management knowledge and attitudes) proved challenging. Results could be biased, as exposure may have affected the outcome.

Regarding nursing implications, community health nurses and school health nurses play an important role in improving students' waste management behaviors. They should promote environmental health in schools to protect students from diseases. Also, school nurses have to provide regular health education interventions to teach students about proper waste disposal and recycling. Furthermore, schools should implement nursing-led waste management education programs. These programs will encourage students to participate in keeping the school clean and help them change their negative attitudes into positive practices.

CONCLUSIONS

At schools in Baiji, the percentage of students with low knowledge of waste management is relatively high. The obvious factors associated with both knowledge and attitude scores were the students' grade level. Most students express a positive attitude toward waste management and the importance of cleanliness, and there is a significant correlation between knowledge and attitude scores.

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