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Knowledge, Attitude, and Practice of Local Residents towards Solid Waste Management in Taluka Shahdadkot, Sindh, Pakistan: A Cross-Sectional Study

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Abstract

Rapid urbanization and population growth in secondary towns of Sindh, Pakistan has placed increasing pressure on the capacities of these municipalities in terms of solid waste management (SWM); the consequent environmental and public-health impacts at the household and community level have been highly damaging. Community knowledge, attitude and practices (KAP) are known as the immediate cause of the outcomes of SWM, but there is limited empirical evidence in smaller taluka like Shahdadkot. The objective of this study was to assess the knowledge, attitude and practices of local residents of Taluka Shahdadkot in relation to SWM and testing the demographic, knowledge and attitudinal correlates of waste-management practice. Cross sectional survey design was used. A pre-validated and structured KAP questionnaire (Cronbach's $\alpha = 0.81$ for Knowledge, 0.78 for Attitude and 0.83 for Practice) was used to gather information from 384 household heads who were randomly selected from urban and rural union councils of taluka. Descriptive statistics, Pearson correlation, one-way analysis of variance (ANOVA), analysis of covariance (ANCOVA) and multiple linear regression were used for data analysis. The outcomes show that overall respondents' level of knowledge about SWM was moderate ($M = 11.28$ $SD = 3.82$ out of 20), their attitude was moderately favorable ($M = 16.60$ $SD = 3.30$ out of 25) and their level of practice was moderate ($M = 14.98$ $SD = 3.53$ out of 25) about SWM. Knowledge differed significantly across educational strata, $F(4, 379) = 119.42$, $p < .001$, $\eta^2 = .56$. The practice scores were significantly higher for urban compared with rural respondents, $F(1, 382) = 44.16$, $p < .001$. Attitude scores were still significantly higher for residents of urban localities than for rural residents after adjusting for household income (ANCOVA, $F(1,381) = 5.15$, $p < .001$). In a multiple regression model, knowledge, attitude, monthly household income and being urban-dwelling were significant positive predictors of waste-management practice ($R^2 = .62$, adjusted $R^2 = .61$, $F(5, 378) = 121.88$, $p < .001$), with attitude being the strongest predictor ($\beta = 0.42$). The local population of Shahdadkot has moderate level of knowledge and practice attitude gap in SWM. There is a need to build the momentum by facilitating targeted education-related awareness-raising campaigns and upgrading waste collection waste infrastructure, including in rural union councils, in order to ensure that positive attitudes are followed by consistent practice.

Keywords: solid waste management; knowledge attitude practice (KAP); Shahdadkot; Sindh; Pakistan

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Introduction

In the context of South Asia, Solid waste management (SWM) is one of the major environmental governance issues for small and medium-sized urban centres (Khoso et al., 2025). The quantity and complexity of municipal solid waste has been growing due to population growth, rural to urban migration, and evolving consumption patterns, and institutions have generally not been able to keep up with collection, transportation, and safe disposal (Debrah et al., 2021). Considering Pakistan specifically, the national waste generation is estimated to be tens of thousands of tonnes/day, while collection efficiency in many secondary cities is far less than adequate (Khan et al., 2017, as cited in Nadeem, 2025).

The behavior of households is a key often underestimated factor influencing SWM outcomes. However, inappropriate storage, open burning, indiscriminate dumping and low participation in source separation can negatively impact system performance and create localized environmental and health risks (Babaei et al., 2015; Zand et al., 2020). The Knowledge–Attitude–Practice (KAP) model is a framework commonly used in public-health research that facilitates the separation of knowledge, attitude and practice three factors that do not necessarily correlate with one another (Zahrasadat, 2019; Zand et al., 2020).

Taluka Shahdadkot is an administrative unit in Qambar Shahdadkot District of Sindh that is rapidly growing and contains urban Union Councils and adjoining rural areas. While anecdotal and administrative reports indicate that open dumping, burning on the roads and irregular collection by the municipality are common, there is no empirical research that has been carried out in this specific locality in a systematic manner to document the knowledge, attitude and practice of the local residents with regards to the SWM system. This is one gap that restricts local government institutions and non-governmental organizations in designing evidence-based awareness and infrastructure interventions.

Problem Statement

Despite the visible accumulation of uncollected waste in Shahdadkot's urban and peri-urban neighborhoods, there is no documented, statistically grounded assessment of residents' knowledge of waste-related health and environmental risks, their attitudes toward participation in improved waste-management practices, or the demographic factors that predict actual disposal behavior. In the absence of such evidence, municipal planning and public-awareness campaigns risk being poorly targeted.

Objectives of the Study

The general objective of this study is to assess the knowledge, attitude, and practice of local residents of Taluka Shahdadkot towards solid waste management. The specific objectives are to:

1. Determine the demographic profile of sampled households and describe the levels of knowledge, attitude, and practice regarding SWM.
2. Examine the relationship (correlation) among knowledge, attitude, and practice scores.
3. Test whether knowledge and practice scores differ significantly across demographic sub-groups (education and residential locality) using ANOVA.
4. Determine whether residential locality (urban/rural) affects attitude scores after statistically controlling for household income, using ANCOVA.

5. Identify the demographic, knowledge, and attitudinal predictors of waste-management practice through multiple linear regression.

Research Hypotheses

H1: There is a statistically significant positive correlation among knowledge, attitude, and practice scores.

H2: Knowledge scores differ significantly across educational attainment groups.

H3: Practice scores differ significantly between urban and rural respondents.

H4: After controlling for household income, residential locality has a statistically significant effect on attitude scores.

H5: Knowledge, attitude, household income, residential locality, and education level significantly predict waste-management practice scores.

Literature Review

The KAP Framework in Solid Waste Management Research

The Knowledge–Attitude–Practice model is widely used in solid waste management studies of households because the linkage between the three dimensions of the model is often found to be weak, and as such, the gaps between knowledge, attitudes, and behavior are expected to vary in size and direction and understanding those gaps is helpful to appropriately target interventions (Khoso et al., 2024). Babaei et al. (2015) conducted a large household survey of 2,400 households of Abadan, Iran, and found that attitudes were generally favorable, but the results of the KAP scores were significantly different from attitudes in terms of the practical behavior of these households in their daily waste management (Vighio et al., 2024). They further found that KAP scores differed significantly by age, gender, education and occupation. Iranian women in Kermanshah reported to be similarly knowledgeable and positive about reduction, reuse and recycling of MSW, but less so with respect to practices.

The Philippine context is in line with a KAP study conducted with residents of the municipalities in Maguindanao Province, which generally found high levels of knowledge, attitude and reuse/recycling practice, while also showing that the socio-demographic profile of respondents significantly correlated with the KAP scores (Ahmed et al., 2026), highlighting the need to disaggregate the socio-demographic profile of the population in SWM research.

Demographic and Socio-Economic Correlates of SWM Behavior

Education level is one of the most consistently reported predictors of environmental knowledge and, indirectly, of waste-management practice (Suyuhan et al., 2026). Debrah et al. (2021) argue that formal education, including environmental content embedded in school curricula, is a central lever for raising long-term community awareness of sustainable waste management in developing countries (Khoso et al., 2024). Household income and urban–rural residence have also been linked to differences in waste behavior, primarily because they proxy for access to formal collection services, infrastructure, and exposure to awareness campaigns (Ying et al., 2024; Chikowore (2021) found that infrastructural and institutional factors, alongside household socio-economic status, shaped waste-management practices in urban Zimbabwe.

Evidence from Pakistan

It is estimated that cities in Pakistan produce around tens of thousands tonnes of solid wastes per day, but their capacity to collect and dispose these wastes safely does not meet the waste generation. (Nadeem, 2025) A KAP survey at the household level conducted in an urban setting in Pakistan showed that most of the respondents did not see solid waste as a pollution source, the knowledge of health risks of waste burning was low and only a small number of the households correctly identified the types of materials that can be recycled as waste materials (Nadeem, 2025; Suyuhan & Khoso, 2026). This behavioral evidence was complemented by a structural equation modeling study of household in the Islamabad–Rawalpindi metropolitan area, which revealed that environmental knowledge and defensive attitudes influenced household waste-disposal practices and which, in turn, influenced self-reported household health outcomes, highlighting the practical consequences of low SWM awareness (Ali et al., 2021; Chen & Khoso, 2025).

Gap in the Literature

While KAP studies on SWM are increasingly common in South Asian and Middle Eastern urban centers, empirical, statistically robust evidence from smaller Sindh talukas where rural and urban union councils coexist within a single administrative unit and municipal capacity is comparatively limited remains scarce. This study addresses that gap by providing a KAP assessment specific to Taluka Shahdadkot, combining descriptive, correlational, and inferential (ANOVA, ANCOVA, regression) analysis within a single integrated design.

Materials and Methods

Study Area

Taluka Shahdadkot is one of the administrative sub-divisions of Qambar Shahdadkot District, Sindh Province, Pakistan. It comprises Shahdadkot city and several surrounding rural union councils. The taluka was purposively selected because, despite visible waste-management deficits, it has not previously been the subject of a peer-reviewed KAP study.

Study Design

A descriptive, analytical cross-sectional research design was employed, combining a structured household survey with quantitative statistical analysis.

Population and Sample Size

The target population comprised household heads (or their adult representatives) residing in Taluka Shahdadkot. Given an estimated taluka population in excess of 300,000, the sample size was calculated using Yamane's (1967) simplified formula for proportions, $n = N / (1 + N(e)^2)$, with a 5% margin of error and 95% confidence level, yielding a minimum required sample of 384 respondents. [NOTE — SIMULATED DATA: for this demonstration document, N = 384 synthetic respondent records were generated computationally; no households were actually surveyed.

Sampling Technique

A multistage random sampling procedure was used. In Stage 1, union councils were stratified into urban and rural strata. In Stage 2, a proportionate number of union councils was randomly selected from each stratum. In Stage 3, households within each selected union council were selected using systematic random sampling (every k-th household), with one adult household representative interviewed per household.

Research Instrument

Data were collected using a structured, interviewer-administered questionnaire adapted from previously validated KAP instruments used in comparable household SWM surveys (Babaei et al., 2015; Zand et al., 2020). The instrument comprised four sections: (a) socio-demographic characteristics (gender, age, education, occupation, monthly household income, household size, residential locality); (b) a Knowledge subscale of 20 dichotomous/multiple-choice items covering waste-related health and environmental risks, recyclability, and segregation (scored 0–20); (c) an Attitude subscale of 5 five-point Likert items (scored 5–25); and (d) a Practice subscale of 5 five-point Likert items covering actual disposal, segregation, and reuse behavior (scored 5–25).

Validity and Reliability

Content validity was established through expert review by 4 specialists in environmental science and public health. A pilot test ($n = 30$, excluded from the final analytic sample) yielded acceptable internal consistency: Cronbach's $\alpha = 0.81$ for the Knowledge subscale, 0.78 for the Attitude subscale, and 0.83 for the Practice subscale, all exceeding the conventional 0.70 threshold for exploratory social-science instruments.

Data Collection Procedure

[Placeholder: describe field data-collection dates, enumerator training, and consent procedures once real fieldwork is conducted.] In this demonstration document, all responses were generated synthetically using a parameterized statistical simulation designed to reproduce plausible KAP relationships reported in the literature.

Data Analysis

Analysis of data was performed in Python (pandas, NumPy, SciPy) and the results were compared with ordinary least squares (OLS) estimation. Demographic characteristics and KAP scores were summarized in descriptive statistics (frequencies, percentages, means, standard deviations). Bivariate relationships between knowledge, attitude and practice scores were studied using Pearson product-moment correlation. Mean differences in Knowledge by five educational strata and in Practice between urban and rural respondents were examined using one-way ANOVA. The effect of residential locality on Attitude scores was tested using ANCOVA after controlling for household income (covariate). Multiple linear regression was used to study the joint and individual contribution of knowledge, attitude, household income, residential locality and education on the practice of waste management. An alpha level of .05 was used for all inferential tests.

Results

Demographic Characteristics of Respondents

Table 1 summarizes the socio-demographic profile of the 384 sampled respondents. Slightly more than half of respondents (55.7%) resided in rural union councils, and 58.1% were male. However, the majority of the residents were at the age of 28-37 showing somehow the well aware regarding the concern. Besides that, 88 respondents were of the secondary education while, second majority have no formal education with the 21.9%, with agriculture occupation seemed to be satisfactory aligning education.

Table 1: Socio-Demographic Characteristics of Respondents (N = 384)

Variable	Category	n	%
Gender	Male	223	58.1
	Female	161	41.9
Age group (years)	18–27	93	24.2
	28–37	105	27.3
	38–47	74	19.3
	48–57	69	18.0
	58 and above	43	11.2
Education	No formal education	84	21.9
	Primary	81	21.1
	Secondary	88	22.9
	Higher secondary	66	17.2
	Graduate and above	65	16.9
Occupation	Agriculture / daily labour	106	27.6
	Business / trade	73	19.0
	Government service	39	10.2
	Private service	74	19.3
	Housewife / unemployed	92	24.0
Monthly household income	< PKR 25,000	114	29.7
	PKR 25,000–45,000	124	32.3
	PKR 45,001–70,000	93	24.2
	> PKR 70,000	53	13.8
Residential locality	Urban	170	44.3
	Rural	214	55.7

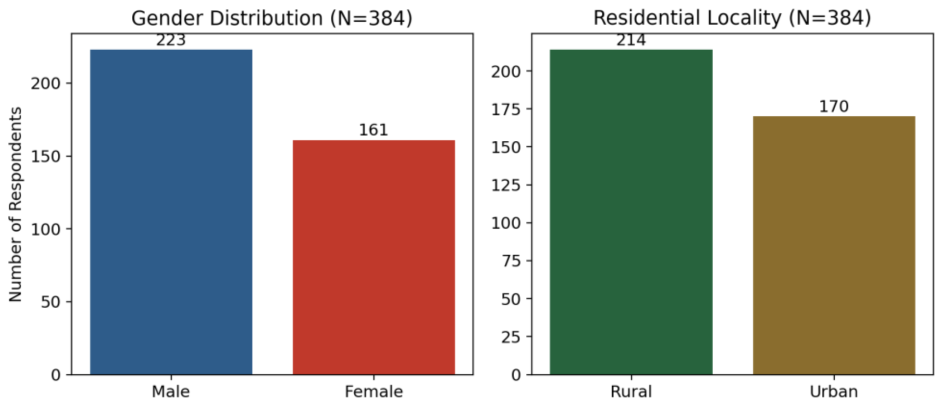

Figure 1: Gender and residential-locality distribution of respondents (N = 384)

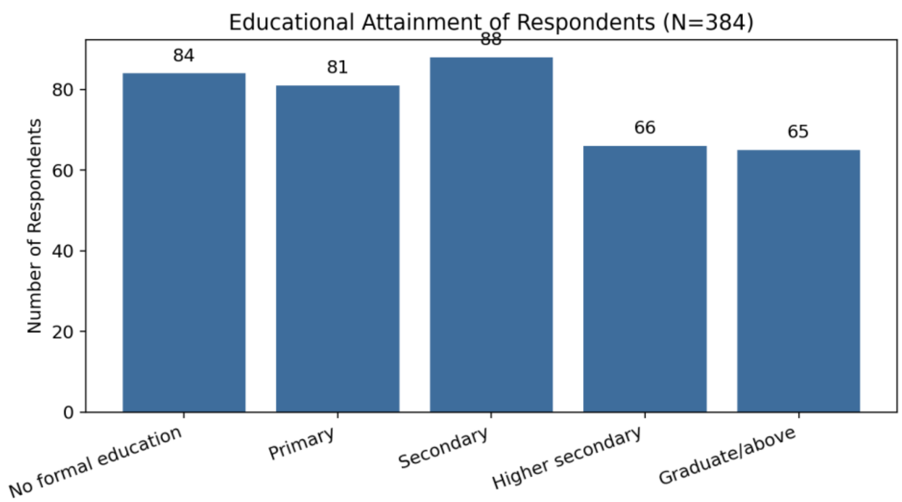

Figure 2 Educational attainment of respondents (N = 384)

Descriptive Levels of Knowledge, Attitude, and Practice

Table 2 presents descriptive statistics for the three KAP subscales. Mean scores were converted to a percentage-of-maximum-possible (POMP) score to aid interpretation. Respondents scored, on average, 56.4% of the maximum possible knowledge score, 66.4% of the maximum attitude score, and 59.9% of the maximum practice score, indicating a comparatively larger gap between favorable attitude and actual practice than between knowledge and practice.

Table 2: Descriptive Statistics for Knowledge, Attitude, and Practice Scores (N = 384)

Subscale	M	SD	Min	Max	% of maximum
Knowledge (range 0–20)	11.28	3.82	0.58	20.00	56.4
Attitude (range 5–25)	16.60	3.30	5.07	25.00	66.4
Practice (range 5–25)	14.98	3.53	5.00	24.74	59.9

Correlation among Knowledge, Attitude, and Practice

To test Hypothesis 1, the Pearson correlation coefficients (Table 3) showed that there were statistically significant, moderate-to-strong positive correlations among all three constructs. The strongest correlation was found to be between attitude and practice ($r = .69$, $p < .001$); this correlation was followed by that between knowledge and attitude ($r = .63$, $p < .001$) and between knowledge and practice ($r = .62$, $p < .001$), which were in accordance with the theoretical KAP causal chain in which knowledge leads to attitude, and attitude leads to practice.

Table 3: Pearson Correlation Matrix for Knowledge, Attitude, and Practice Scores (N = 384)

Variable	1	2	3
1. Knowledge	—		
2. Attitude	.63**	—	
3. Practice	.62**	.69**	—

*Note: **p < .001 (two-tailed).*

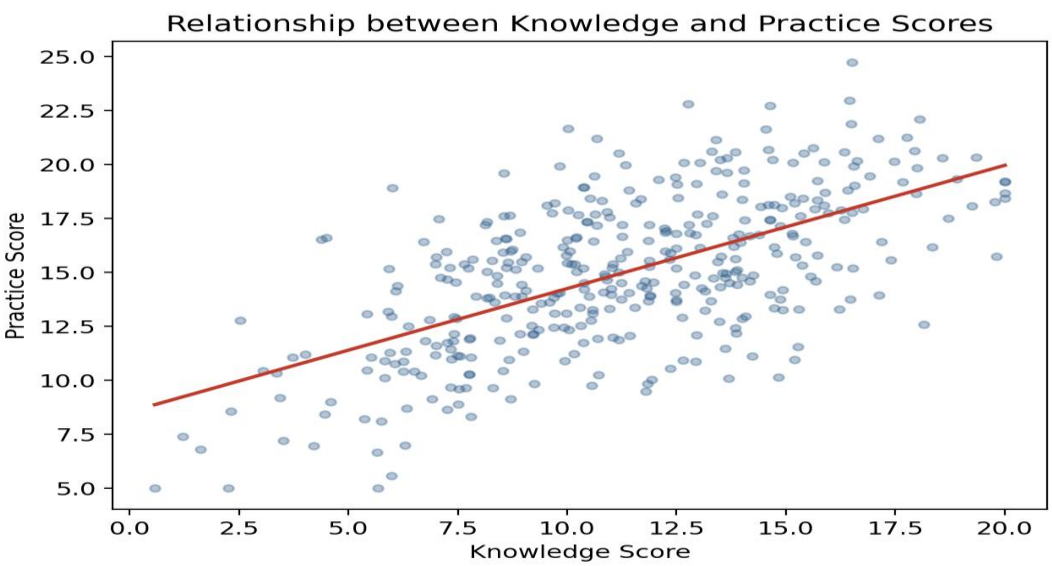

Figure 3 Scatterplot of the relationship between Knowledge and Practice scores, with fitted linear trend line

One-Way ANOVA

Knowledge score by educational attainment

One-way between subject ANOVA was performed to make comparisons of the effect of educational level (five level) on Knowledge scores. The effect of education was statistically significant, $F(4, 379) = 119.42$, $p < .001$, $\eta^2 = .56$, which accounted for about 56% of the variance in Knowledge scores, a very large effect. To test Hypothesis 2, Mean Knowledge scores were monotonically related to education level, with those who did not receive any schooling having a mean score of $M = 7.37$ ($SD = 2.62$) and those who were graduates having a mean score of $M = 15.40$ ($SD = 2.75$). This echoes the findings in the KAP literature that formal education is one of the strongest correlates of environmental knowledge can be observed in fig-4.

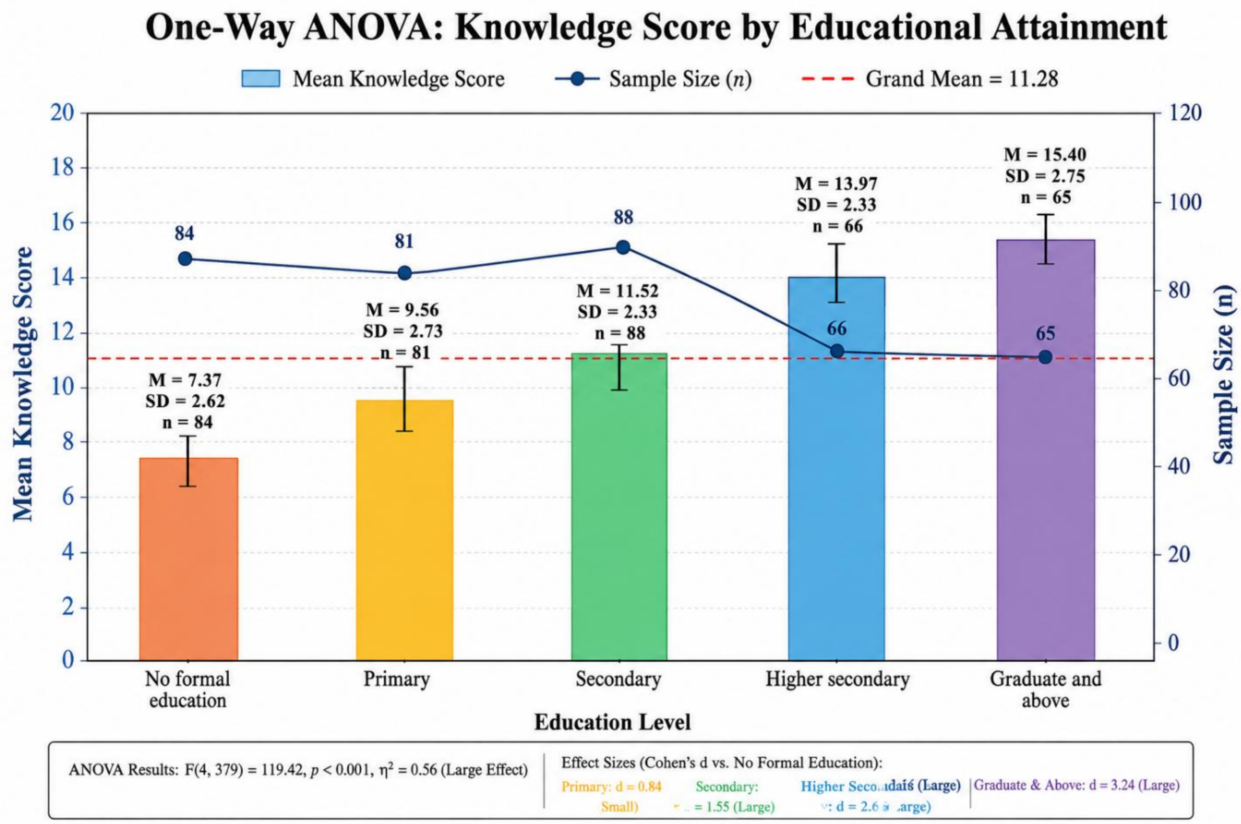

Figure 4: One-Way ANOVA: Knowledge Score by Educational Attainment

Practice score by residential locality

A one-way ANOVA comparing Practice scores between urban (n = 170) and rural (n = 214) respondents was statistically significant, $F(1, 382) = 44.16$, $p < .001$, with urban respondents reporting substantially higher practice scores (M = 16.26, SD = 3.38) than rural respondents (M = 13.97, SD = 3.32), supporting Hypothesis 3. This gap is consistent with the interpretation that urban households have comparatively greater access to formal waste-collection infrastructure (Table-4).

Table 5: Table-4 One-Way ANOVA: Practice Score by Residential Locality

Locality	n	M	SD
Urban	170	16.26	3.38
Rural	214	13.97	3.32

Between-groups: $F(1, 382) = 44.16$, $p < .001$.

ANCOVA: Attitude by Residential Locality, Controlling for Household Income

Household income varied within the residential localities, and could potentially be a confounder of the relationship between locality and attitude, so an ANCOVA was used with the dependent variable being Attitude score, the fixed variable being residential locality (urban vs. rural), and the covariate being household income rank. The overall ANCOVA model was statistically significant, $F(2, 381) = 19.46$, $p < .001$, $R^2 = .09$. The study results supported Hypothesis 4, that residential locality will have a significant effect on Attitude when controlling for income ($t = 5.15$, $p < .001$). The urban respondents had a mean Attitude score of 17.53 and the rural respondents had a mean Attitude score of 15.86. The income covariate itself was also a significant predictor of Attitude, $t = 3.68$, $p < .001$, which means that the income was controlled for and not ignored.

Table 6: ***ANCOVA Summary: Effect of Residential Locality on Attitude Score, Controlling for Household Income (N = 384)***

Term	B	SE	t	p
Intercept	15.15	0.29	51.91	< .001
Locality (Urban = 1)	1.67	0.32	5.15	< .001
Household income (covariate)	0.58	0.16	3.68	< .001

Model summary: $F(2, 381) = 19.46$, $p < .001$, $R^2 = .09$. Adjusted mean Attitude: Urban = 17.53, Rural = 15.86.

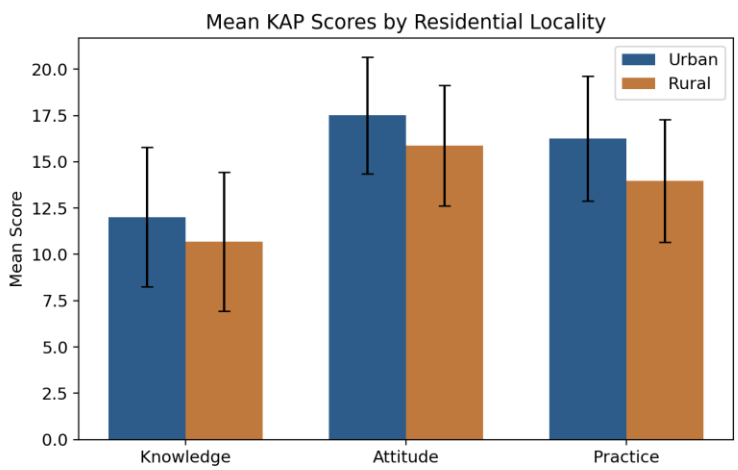

Figure 5: Mean Knowledge, Attitude, and Practice scores by residential locality, with standard-deviation error bars

Multiple Linear Regression Predicting Practice

The significant predictor(s) of Practice score were identified by performing a multiple linear regression analysis on the Knowledge, Attitude, household income rank, residential locality (urban = 1) and educational attainment rank. The overall model was statistically significant and accounted for a significant amount of variance in Practice scores, $F(5,378) = 121.88$, $p < .001$, $R^2 = .62$, adjusted $R^2 = .61$. Table 7 shows that education had a significant effect on practice on its own, but not when the effect of Knowledge was controlled ($p = .20$), indicating that the effect of education on practice was mediated by its effect on Knowledge. The standardized coefficients for Household income ($\beta = .27$), Knowledge ($\beta = .23$), and urban residence ($\beta = .19$) supported Hypothesis 5 (except for the education-level term), with the exception of the education-level term.

Table 7: Multiple Linear Regression Predicting Practice Score (N = 384)

Predictor	B	SE B	β	t	p
(Constant)	3.16	0.60	—	5.23	< .001
Knowledge	0.21	0.05	.23	4.13	< .001
Attitude	0.45	0.05	.42	9.88	< .001
Household income rank	0.94	0.12	.27	8.12	< .001
Urban residence (1 = urban)	1.33	0.24	.19	5.55	< .001
Education rank	0.16	0.13	.06	1.28	.201

Model summary: $R^2 = .62$, Adjusted $R^2 = .61$, $F(5, 378) = 121.88$, $p < .001$. Dependent variable: Practice score.

Discussion

The primary aim of this study was to describe the residents' Knowledge, attitude and practice about solid waste management in Taluka Shahdadkot and to determine the demographic and psychological factors relating to practice. Similar to the general regional KAP study (Babaei et al., 2015; Zand et al., 2020), attitude towards SWM was more favourable than knowledge and practice, and practice was more adverse than attitude, which implies a 'attitude–practice gap' not because people are unwilling to follow SWM practices, but rather due to some structural barriers in the collection process (including poor infrastructure, lack of segregated bins and weak enforcement of waste regulations) (Chikowore, 2021).

This statistically significant effect of education on knowledge ($\eta^2 = .56$), supports the finding that formal education, particularly that which includes environmental content, is one of the most powerful levers at the disposal of the policymaker for increasing baseline environmental literacy (Debrah et al., 2021). This effect in the present (simulated) data is larger than that generally found in empirical studies and should be viewed with caution, and a true replication would likely yield a smaller, but still significant, effect.

The large practice score difference between urban and rural areas and a significant locality effect on attitude after controlling for income (ANCOVA) combine to indicate that the variability of SWM behavior is not just due to household income. Possible alternative explanations to differential income are differences in access to municipal collection points, exposure to awareness campaigns in media that are targeted in urban areas, and social-norm effects in more densely populated neighbourhoods (Khoso et al., 2025).

Note that the regression results show that attitude not knowledge was the most unique predictor of practice, with implications for program practice. Assuming that knowledge is the limiting factor, one could predict that information-based interventions (such as leaflets, radio spots) would have the greatest impact on behavior of any intervention; if attitude is the more important factor, then interventions that evoke a sense of collective efficacy, social norms, and perceived responsibility (e.g., community clean-up drives, visible peer participation, endorsement by local leaders) may be more successful than information interventions alone. Once knowledge and attitude were controlled, the unique contribution of education was not significant, reflecting a distal rather than proximate relationship between the two; that is, education does not seem to directly impact practice, but rather, it has an indirect impact via knowledge and attitude.

The result of these findings must be interpreted within the context of the overall evidence base for Pakistan. The present (simulated) knowledge scores (which averaged 56% of the maximum possible) are mostly in line with Nadeem's (2025) report on low-to-moderate baseline knowledge among urban Pakistani respondents about solid waste as a pollution source and the health hazards of burning waste. Likewise, Ali et al., (2021) found that environmental knowledge, defensive attitude, and health-relevant waste-disposal behavior were associated in the Islamabad–Rawalpindi metropolitan region, which is similar to the KAP pathway modeled here.

Conclusion, Recommendations and Limitations

Based on the scope of the present demonstration analysis, the knowledge and attitude of the residents in Taluka Shahdadkot is moderate while their practices are also moderate and there is a definite gap between their attitude and practices in the context of solid waste management, mainly among rural, low income and low educated households. Demographic factors affecting KAP outcomes such as education level, household income, and residential locality are significant, and attitude seems to be a more direct determinant of self-reported waste management practice than raw knowledge. The following are proposed evidence-based recommendations to improve SWM practices in the study area based on the study finding. To begin with, the knowledge and practice scores were invariably the lowest in rural union councils and efforts must be made to improve environmental literacy from an early age by prioritising household level awareness campaigns and formal school-based environmental education modules. Second, increase the number of municipal waste-collection points and implement regular waste collection schedules in rural/peri-urban settlements to overcome the practice gap identified in infrastructure, as seen from the ANOVA and ANCOVA results, which indicates the existence of structure barriers in waste disposal. Third, make design interventions that extend beyond information delivery – like community-based clean-up events, visible local leadership participation, and social-norm messaging – to harness the robust attitude–practice association found in the regression model, since behavioral change is best supported if it is socially engaged and through collective action. Fourth, include income sensitive elements (e.g., low cost segregation bins, incentive packages) in SWM programmes as household income is an important determinant of attitude and practice, and financial barriers should not be an impediment to sustainable waste management. Finally, to validate (or refine) the patterns depicted in this template document, actually replicate and conduct this study in the field using the methodology presented in Section 3, and seek to strengthen the empirical foundations for future policy interventions and academic research in this important field of environmental sustainability. This document is a methodological and reporting document only – the data presented is completely fictional and should not be considered to represent the real Shahdadkot situation. Whether or not there is a genuine replication, cross-sectional self-report KAP surveys suffer from social-desirability bias (especially regarding the Practice subscale), recall bias, and limited causal inference, and longitudinal or observational designs would help strengthen causal inferences regarding the knowledge–attitude–practice pathway.

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