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ANALYZING THE HEALTH EFFECTS OF THE SOLID WASTE MANAGEMENT SYSTEM ON URBAN RESIDENTS OF MULTAN

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ABSTRACT

Solid waste management (SWM) is an essential component of urban sustainability, involving the collection, transportation, treatment, and disposal of waste materials to decrease environmental pollution and promote public health. The rapid growth of urban areas has intensified waste generation, leading to significant environmental and health challenges. The objectives of the research were to examine the improper waste disposal effects on health and to study the solutions for improving SWM in urban areas of Multan. The study was quantitative in nature and survey research design was exploited to conduct the research. The residents who were living near waste dumps or affected by landfill sites, were the target population. A stratified random sampling technique was employed and collected data from 300 respondents by using the questionnaire. The statistical analysis was done by using the SPSS. The findings highlight significant health risks, particularly for those living near waste dumps, and suggest a need for culturally sensitive solutions to enhance SWM effectiveness. The study's findings highlight the dire need to improve SWM practices in urban areas of Multan. Results show clear health risks are linked with poor waste management, exclusively for exposed populations such as women, the elderly, and the less educated, and recommend that waste management reform must be inclusive. Recommendations include enhancing public awareness programs, improving waste disposal infrastructure, and including culturally delicate approaches to changing attitudes toward waste management. Moreover, efforts should concentrate on reducing the closeness of waste dumps to inhabited areas and modifying the environmental dangers posed by burners and landfills.

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INTRODUCTION

Sustainable Development Goad 6 focus on the clean water and sanitation. One in three people live without sanitation. This is causing unnecessary disease and death. Although huge strides have been made with access to clean drinking water, lack of sanitation is undermining these advances. If we provide affordable equipment and education in hygiene practices, we can stop this senseless suffering and loss of life. In cities around the world, managing solid waste is a big problem, especially in growing countries where cities grow faster than the services can handle. In Pakistan the most populated province Multan, facing difficulty to deal with solid waste properly. This causes worries about the environment and people's health (Breukelman et al., 2022). Although it's under consideration to solve these problems, but it shows the need for better city planning and waste management to protect the environment and people's well-being.

Every day a lot of solid waste is produced in cities of Multan due to limited resources that many places have trouble collecting and disposing of the waste even though there are efforts to manage it (Arshad et al., 2021). Making the Problem is getting worse as much of the waste is not collected and is dumped in open areas (Adedara et al., 2023; Earnest et al., 2021). This poor waste management harms the environment and can cause serious health problems. Careless waste practices cause health issues, especially for people living near dumps or burning sites. Life is miserable and poor birth outcomes along with a higher risk of breathing problems in such places (Vinti et al., 2021; Etea et al., 2021).

For improving waste management, public contribution and mindfulness are so significant. To teach people about reducing waste, proper disposal programs are being introduced in Multan to help to generate a community that maintains the environment (Iqbal et al., 2022). Though the issues with waste management are complex and involve money and technical infrastructure issues (Khan & Ali, 2021). Insufficient financial resources make waste management-related things more complicated. We need to think especially in Multan to find good, long-lasting solutions for waste management. A serious effort is required about these money and cultural issues, so the plans fit the needs of the people. Short solid waste management (SWM) in Multan poses significant environmental and public health hazards. The research highlights how poor waste disposal practices, particularly for those living near landfills or incinerators, contribute to adverse health outcomes (Vinti et al., 2021; Etea et al., 2021). It's essential to address these SWM challenges to safeguard public health for People residing in such areas face a higher likelihood of respiratory illnesses and negative birth outcomes.

In developing effective waste management strategies, public participation and awareness play a crucial role. In urban areas, initiatives intended for humanizing residents on waste reduction and proper disposal, similar programs are helping to increase conservation awareness and decrease illegal removal (Iqbal et al., 2022). Though SWM challenges are complex in Multan and influenced by socio-economic, technical, and infrastructural factors (Khan & Ali, 2021). To invest in modern infrastructure, economic limitations often hinder the region's ability. Besides public attitudes, cultural norms towards waste disposal further confuse efforts to implement sustainable solutions. To address these unique challenges effectively, it is necessary that in Multan, cultural realities and socio-economic strategies should be revised. So, how well the system works, the rules, and policies for waste management in Multan are very important (Ivanova, 2024). We need stronger policies and better support for the institutions that handle waste to improve waste management. However, these policies are not always followed properly, which makes it harder to manage waste. Modern investments are needed as Multan does not have sufficient progressive systems for dealing out and recycling waste (Safar et al., 2021). To reduce the harm to the environment and people's health, the use of new technology can helpful in controlling the speedy climate change (Zulfiqar et al., 2020; Hajam et al., 2023).

The research concludes that damaged land, polluted water, and bad air quality, like environmental problems, are closely linked to public health issues (Abubakar et al., 2022). We can gain useful ideas that might lead to better, more customized solutions for managing waste by comparing waste management methods in Multan with other regions (Akmal et al., 2023). In Multan the future of solid waste management (SWM) will hang on factors like new technology, growing cities, and increasing population. It is crucial to improve SWM, take action through policy changes, build better infrastructure, raise public awareness, and involve communities (Wu et al., 2023). For protecting the environment and keeping people healthy, proper waste management is important in Multan (Shoaib, 2006).

Breathing problems and complications during childbirth, especially for those living near waste dumps or incinerators, are consequences of **i**neffective solid waste management. Whereas efforts to involve the public in waste decrease and raise awareness are ongoing and influencing people's views on waste disposal. No doubt it is challenging and requires culturally sensitive solutions. The prevailing situation in Multan's SWM illustrates an urgent need for a well-rounded plan that reflects procedural, economic, and cultural factors to improve both environmental conditions and health for people. Insufficient waste management poses substantial public health risks, mainly in Multan. Various health complications, including respiratory and gastrointestinal diseases, are due to poor garbage

disposal (Kwun Omang et al., 2021). Respiratory illnesses are a major concern linked to improper waste disposal. Openly burning waste releases dangerous air pollutants, for example, particulate matter (PM), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs) (Okedere et al., 2019). If people stay in such pollutants for a long time, they can irritate the respiratory area, deteriorate asthma, and cause continuing disruptive pulmonary disease (Jiang et al., 2016). Those people who were living near garbage dumps, where open burning is common, experience higher rates of respiratory issues. Multan Health Department reported increased coughing and wheezing among those living close to waste sites (Mehmood et al., 2021). Poor waste disposal also poses the risk of gastrointestinal illnesses, mostly due to water and food pollution. Leachate from waste can introduce harmful microorganisms and chemicals into water sources (Abdel-Shafy et al., 2023). Consuming contaminated water or food can lead to gastrointestinal infections and diarrhea (Lin et al., 2022). Multan Medical College study identified in 2018 a significant correlation between waste disposal practices and the frequency of respiratory and gastrointestinal diseases among nearby residents (Hussain et al., 2023).

Scarcity of waste management produces air pollution from open removal and unrestrained burning, discharging destructive contaminants like particulate matter (PM), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) (Busolo & Njabira, 2022). Contact with these toxins can cause breathing issues and increase the risk of cardiac diseases (Verma & Quraishi, 2023). Anjum et al. (2021) studied air quality in Pakistan, highlighting sources, policies, and challenges. It also studied health risks and increasing death rates due to air contamination. Resolutions comprise intensive care, new technologies, and communication among public, private, and stakeholders.

Water quality is also threatened due to poor waste management, and in consequence, public health is affected (Azizullah et al., 2011). Toxic leachate, which can contaminate soil and water sources, is because of rainwater leakage through landfill waste (Boateng et al., 2019). Use of contaminated water can result in stomach issues, skin diseases, and long-term health risks. The World Health Organization reported high impurities in Multan's groundwater related to waste disposal (Kumar et al., 2023).

In reduction and recycling efforts, public attitudes significantly influence the success of waste management (Fadhullah et al., 2022). Citizens' behaviors in Multan shape littering practices, waste disposal, and recycling, which directly impact city cleanliness and waste collection efficiency (Olukanni et al., 2020). For promoting proper disposal practices, understanding of these perceptions is vital. In shifting public attitudes, education and awareness programs play a key role (Owojori et al., 2022). In Multan, NGOs research shows that such enterprises advance public understanding of waste exclusion and reprocessing (Khan, 2023), highlighting the importance of besieged mindfulness movements.

RESEARCH METHODOLOGY

To analyze the health effects of solid waste management (SWM) on urban residents in Multan , the study employed a quantitative methodology. The study examined perceptions of health impacts related to poor waste handling practices. The main focus was on variables such as gender, age, education, and experience. The descriptive approach permitted an in-depth understanding of how different demographic groups supposed the risks postured by ineffective SWM. The target population included urban residents of Multan. The residents, particularly those who were living near waste dumps or affected by landfill sites, were participants in the study. To ensure representation across different genders, age groups, education levels, and work experience, a stratified random sampling technique was employed. The sample was comprised of 300 participants, equally divided among different demographics to offer understandings of gender-wise, age-wise, education-wise, and experience-wise responses.

The data were collected through a structured questionnaire. The questionnaire was based on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire focused on factors of health risks, air and water pollution, cultural practices, public awareness, and SWM infrastructure. The questionnaire was developed from literature and pilot-tested to ensure reliability and validity. The data were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics, specifically correlation analysis, to assess the differences between groups.

RESULTS AND DISCUSSION

Table 4.1: Descriptive statistics for demographic variables

Variables	Category	Frequency (%)
Gender	Male	188 (62.7)
	Female	112 (37.3)
Age Group (Years)	≤25 Years	28 (9.3)
	26-35 Years	58 (19.3)
	36-45 Years	50 (16.7)
	46-55 Years	99 (33.0)
	>55 Years	65 (21.7)

Table 1 depicts the frequencies and percentages of the demographic variables.

Table 2: *Correlation Matrix for health risks of living near waste (HRLW), air quality concerns (AQC), water contamination (WC), disease incidence rates (DIR), public awareness (PA), cultural practices and beliefs (CPB), impact of stray animals (ISA) and local solid waste management effectiveness (LSWME)*

Variable	Mean ± SD	1	2	3	4	5	6	7	8	9
HRLW	19.39±1.93	1								
AQC	13.84±2.45	.974**	1							
WC	18.68±2.10	.871**	.830**	1						
DIR	20.97±2.14	.719**	.674**	.852**	1					
PA	16.75±2.95	.727**	.680**	.823**	.903**	1				
SWMI	15.80±2.40	.645**	.628**	.723**	.816**	.887**	1			
CPB	10.29±1.97	.593**	.572**	.652**	.736**	.799**	.873**	1		
ISA	15.12±2.16	.473**	.443**	.515**	.623**	.691**	.768**	.886**	1	
LWME	18.84±2.39	.958**	.984**	.825**	.681**	.682**	.630**	.567**	.445**	1

Where: HRLW= Health Risks of Living Near Waste, AQC= Air Quality Concerns, WC= Water Contamination, DIR= Disease Incidence Rates, PA= Public Awareness, SWMI= Slod Waste Management Infrastructure, CPB= Cultural Practices and Beliefs, ISA= Impact of Stray Animals, LSWME= Local Solid Waste Management Effectiveness

Table 2, depict correlation analysis for health risks of living near waste (HRLW), air quality concerns (AQC), water contamination (WC), disease incidence rates (DIR), public awareness (PA), cultural practices and beliefs (CPB), impact of stray animals (ISA) and local solid waste management effectiveness (LSWME). From the results we conclude that health risks of living near waste significantly and positively correlated with air quality concerns, water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness. Similarly, air quality concerns significantly and positively correlated with water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness. Water contamination is significantly and positively correlated with disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness. Disease incidence rates significantly and positively correlated with public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness. Public awareness is significantly and positively correlated with cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness. Cultural practices and beliefs significantly and positively correlated with impact of stray animals and local solid waste management effectiveness. Furthermore, impact of stray animals and local solid waste management effectiveness are significantly and positively correlated with each other.

Table 3: *t-test for health risks of living near waste (HRLW), air quality concerns (AQC), water contamination (WC), disease incidence rates (DIR), public awareness (PA), cultural practices and beliefs (CPB), impact of stray animals (ISA) and local solid waste management effectiveness (LSWME) between male and female respondents*

Variables	Mean ± SD		t-value	p-value	Cohens' d	95% CI	
	Male (188)	Female (112)				LL	UL
HRLW	19.75±1.80	18.81±2.02	4.126	.000	.59	.48	1.37
AQC	14.26±2.31	13.15±2.53	3.864	.000	.55	.54	1.67
WC	19.02±1.92	18.10±2.25	3.773	.000	.54	.44	1.40
DIR	21.29±1.98	20.44±2.30	3.403	.000	.48	.36	1.35
PA	17.19±2.70	16.02±3.20	3.376	.001	.48	.49	1.85
SWMI	16.15±2.23	15.21±2.56	3.349	.001	.48	.39	1.50
CPB	10.62±1.84	9.74±2.07	3.803	.000	.54	.42	1.33
ISA	15.53±1.99	14.44±2.27	4.341	.000	.62	.60	1.58
LWME	19.28±2.25	18.11±2.44	4.212	.000	.60	.62	1.72

Where: HRLW= Health Risks of Living Near Waste, AQC= Air Quality Concerns, WC= Water Contamination, DIR= Disease Incidence Rates, PA= Public Awareness, SWMI= Slod Waste Management Infrastructure, CPB= Cultural Practices and Beliefs, ISA= Impact of Stray Animals, LSWME= Local Solid Waste Management Effectiveness

Table 3 shows the results of independent samples t-test for health risks of living near waste, air quality concerns, water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness between male and female respondents. From the results we conclude that the levels of health risks of living near waste, air quality concerns, water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness are significantly higher in male respondents than that of female respondents.

Table 4: *ANOVA for health risks of living near waste (HRLW), air quality concerns (AQC), water contamination (WC), disease incidence rates (DIR), public awareness (PA), cultural practices and beliefs (CPB), impact of stray animals (ISA) and local solid waste management effectiveness (LSWME) among different age groups of the respondents*

ANOVA

Variables	Sov	Sum of Squares	df	Mean Square	F	Sig.
	Between Groups	75.590	4	18.897	5.360	.000
HRL	Within Groups	1039.997	295	3.525		
	Total	1115.587	299			
	Between Groups	156.344	4	39.086	7.051	.000
AQ	Within Groups	1635.292	295	5.543		
	Total	1791.637	299			
	Between Groups	103.801	4	25.950	6.338	.000
WCC	Within Groups	1207.836	295	4.094		
	Total	1311.637	299			
	Between Groups	62.804	4	15.701	3.538	.008
DIR	Within Groups	1308.982	295	4.437		
	Total	1371.787	299			
	Between Groups	116.158	4	29.040	3.449	.009
PA	Within Groups	2484.092	295	8.421		
	Total	2600.250	299			
	Between Groups	95.269	4	23.817	4.318	.002
SWM	Within Groups	1627.328	295	5.516		
	Total	1722.597	299			
	Between Groups	90.661	4	22.665	6.231	.000
CPB	Within Groups	1073.109	295	3.638		
	Total	1163.770	299			
	Between Groups	57.628	4	14.407	3.167	.014
ISA	Within Groups	1342.052	295	4.549		
	Total	1399.680	299			
	Between Groups	152.776	4	38.194	7.243	.000
LWME	Within Groups	1555.544	295	5.273		
	Total	1708.320	299			

Where: HRLW= Health Risks of Living Near Waste, AQC= Air Quality Concerns, WC= Water Contamination, DIR= Disease Incidence Rates, PA= Public Awareness, SWMI= Slod Waste Management Infrastructure, CPB= Cultural Practices and Beliefs, ISA= Impact of Stray Animals, LSWME= Local Solid Waste Management Effectiveness

Table 4 shows the results of ANOVA for health risks of living near waste, air quality concerns, water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness among different age groups of the respondents. From the results we conclude that the levels of health risks of living near waste, air quality concerns, water contamination, disease incidence rates, public awareness, cultural practices and beliefs, impact of stray animals and local solid waste management effectiveness are significantly different among different age groups of the respondents. Furthermore, the maximum difference found between age groups “46-55 years old” and “18-25 years old” of the respondents.

DISCUSSION

The study shows that poor solid waste management (SWM) in Multan harms urban residents' health. The data reveals strong links between health risks and factors like air pollution, dirty water, and disease rates. These results prove that environmental problems directly affect public health. The study revealed that male respondents exhibited significantly greater awareness of health risks. This disparity may stem from increased environmental exposure or heightened risk perception among males. Conversely, women's health concerns may be underreported or internalized due to their predominant engagement in domestic responsibilities. These findings highlight the need for gender-sensitive awareness programs. Such initiatives can address differences in health risk perception. They can also improve reporting of health issues among both men and women.

The ANOVA results indicated significant differences across age groups. Respondents aged 46–55 years reported the highest level of concern. This may be due to prolonged exposure or greater awareness of long-term health effects. Higher education levels and extended urban living experience were also linked to increased concern. These patterns emphasize the role of education and awareness in shaping health-conscious attitudes toward solid waste management.

The findings confirmed the harmful effects of poor SWM infrastructure. Living close to waste sites increases health risks. Low public awareness adds to the problem. Cultural practices also influence waste disposal habits. The presence of stray animals worsens the situation. These factors together shape urban life in Multan. Environmental and social conditions are closely linked to health outcomes.

CONCLUSION

The study validates that in urban residents of Multan, a clear connection exists between ineffective solid waste management (SWM) and significant health risks. The findings of the study emphasize addressing health risks through individual involvements, considering gender, age, education, and experience differences in public perception. Increasing public awareness, enhancing waste management infrastructure, and putting specific regulations that address socioeconomic disparities into place should be the main goals of efforts to mitigate the negative health effects of inadequate SWM. These strategies can help in the development of a healthier, cleaner urban environment by encouraging community involvement and giving fair solutions first priority.

RECOMMENDATIONS

The study’s findings highlight the dire need to improve SWM practices in urban areas of Multan. Results show clear health risks are linked with poor waste management, exclusively for exposed populations such as women, the elderly, and the less educated, and recommend that waste management reform must be inclusive. Recommendations include enhancing public awareness programs, improving waste disposal infrastructure, and including culturally delicate approaches to changing attitudes toward waste management. Moreover, efforts should concentrate on reducing the closeness of waste dumps to inhabited areas and modifying the environmental dangers posed by burners and landfills.

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