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EVALUATION OF SOLID WASTE MANAGEMENT WORKERS' KNOWLEDGE, ATTITUDES, AND PRACTICES: A CROSS- SECTIONAL STUDY OF THE SINDH SOLID WASTE MANAGEMENT BOARD, HYDERABAD

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ABSTRACT

Solid waste management presents significant occupational health hazards globally, particularly in developing nations like Pakistan. This study investigates the Knowledge, Attitude, and Practices (KAP) of solid waste workers employed by the Sindh Solid Waste Management Board (SSWMB) in Hyderabad. Employing a cross-sectional quantitative design, structured questionnaires were administered to 384 solid waste collectors and data were analyzed using SPSS, One-way ANOVA, *t*-test, and Post hoctest for multiple comparisons among groups. The study aimed to evaluate workers' awareness of hazardous exposures and safety measures. Findings indicate gaps in knowledge, positive attitude and practices such as Personal Protective Equipment (PPE) usage were found to be inadequate. Recommendations include targeted training initiatives and improved provision of PPE to mitigate occupational risks and promote the safety and well-being of workers engaged in solid waste management practices.

Keywords: KAP, Waste Workers, Solid Waste management, Occupational safety and Health, Hazards, Health risk, Developing countries and Municipal solid waste

INTRODUCTION

Solid waste collection throughout the world is a daily task. Their risk of health is a global issue (Cointreau, 2006; Thirarattanasunthon et al., 2012). Solid waste collection workers and waste pickers are exposed to Occupational illness and injuries are major issues at workplaces in developing countries. This serious problem has been raised by the International Labor Organization which provides statistical data that around 250 million workers worldwide have faced occupational injuries (Cabrera-Ormaza, 2018).

Particularly, as per estimates related to workers involved in waste management fields, over 213 million workers are exposed to non-fatal accidents. These incidents result in injuries which sometimes lead to death. Their death toll reaches half a million in case of higher severity of incidents (Kasemy et al., 2021a).

In most developing countries with poor financial resources, waste collectoroccupational risk behavior is largely unmanaged. It is stressed by ILO that gender disparities, low levels of education, poverty and skills are key difficulties that must beaddressed to make tangible progress on UN Sustainable Development Goals 8 (SDG8) decent work and economic growth, if workers die in the workplace that not affect the organization but affect the overall economy of the country (Newcomb, 2016).

Data on accidents in developing countries are not recorded properly, due to a lack of proper recording and notification systems (Hämäläinen et al., 2006). However, indeveloping countries, the situation is worse, as workers in developing countries are exposed to more accidents than in developed countries (Ali, Wang, et al., 2017; Elmubarak et al., 2021; Wath et al., 2011).

Though every occupation worker is exposed to different hazardous situations, Solidwaste workers have higher injuries and occupational risk than industrial workers (Rushton, 2003; World, 2010).

Similarly, (Sapkota et al., 2020) state that compared to other fields of occupational Health and safety risks of municipal solid waste workers are higher due to their health- related issues such as allergies, physical injuries, musculoskeletal complaints, diarrhea, fungal infection, respiratory tract infection, gastrointestinal disease, skin, eyeinjuries, fracture, sharp backache, dog and rats' bites, lacerations, abrasions, sprains also incident occur burns from fires (Taber, 2018; Wassiem et al., 2021).

Such occupational accidents occur mostly due to improper waste disposed of such as broken needles, glass and sharp pins and microbial contamination that causes transmission of blood-borne pathogens, Immunodeficiency virus (HIV), tetanus, Hepatitis B (HBV), Hepatitis C (HCV) (Drda et al., 2002; Rachiotis et al., 2012; Squeriet al., 2006; Tarantola et al., 2006).

Pakistan is one of the developing countries in Asia, and solid waste is collected manually. It is therefore necessary to explore the knowledge, attitude and practices (KAP) of solid waste workers so that precautionary measures can be recommended. This study will be carried out to fulfil the above research gap of exploring the KAP ofsolid waste workers of Sindh Solid Waste Management Board (SSWMB), Hyderabad for the betterment of workers and solid waste management.

Literature Review

Occupational Health Hazards of Solid Waste

Solid waste workers are at high risk. They are exposed to health and safety hazards more than other workers. Municipal workers are facing serious health-related problems (Ali, Ashraf, et al., 2017). This is also justified that the Municipal waste worker industry was the fifth most dangerous industry in the U.S., with more dangerousjobs than police officers and firefighters (Kuijer & Frings-Dresen, 2004; Olorunnisholaet al., 2010).

(Jerie, 2016a; Rogoff, 2015) have reported that Municipal workers were facing physicalinjuries and chemical and biological health hazards. Physical injuries include fracture,wound, burns, dog and rat bites, abrasions, sharp backache, and eye injuries, chemical hazards from gaseous emission of methane, carbon dioxide, hydrogen sulphide, and carbon monoxide furthermore lead poisoning from lead-containing batteries creates respiratory illness, nausea and headaches and biological hazards include viral hepatitis,HIV, diarrhea and tetanus.

In Job, workers were less productive due to an increase in work burden that causes musculoskeletal disorders that affect quality of life (Yasobant & Rajkumar, 2014). In Pakistan, workplace safety and health are still infancy which caused an increase fatal accident rate (Hamid et al., 2019).

Chemical poisoning was placed in open trash resulting in direct effects on human health, and children, hazardous waste in open trash has toxic substances that directly affect the environment and human health (Albritton & Kuijpers, 1999).

In developing countries low social status and lack of awareness to waste workers regarding solid waste management personal protective equipment (Jerie, 2016b).

Knowledge, Attitude and Practice of Solid Waste Workers

Various studies have been conducted in this field Knowledge, attitudes and Practices of Municipal waste workers across the globe. Some are here under.

Study conducted by (Gebremedhin, 2016) aimed to assess the Knowledge, attitude andpractices of solid waste workers for the prevention of health hazards in one of the sub- cities of Ethiopia. Data was collected from 406 solid workers through a semi-structuredquestionnaire and observational checklist. One-third of the participants had a favorable

attitude, in addition to more than half of the participants had enough satisfactory knowledge about the prevention of the risks related to the work. However, only 32% are known to use safety practices.

similar study was conducted in Egyptian on solid waste workers (Kasemy et al., 2021a) to assess Knowledge, attitude and practice towards hazardous exposure, health disorders and safety measures. Two groups of waste workers were involved in the data collection, one who indirectly involved was the office management group other directly involved was municipal waste workers, A Total of 275 workers were equally taken from both groups, and questionnaires were distributed about knowledge, attitudes, and practices regarding waste management. An inferential statistics test (t-test) was conducted to compare the groups for Quantitative variables, Moreover, a Chi-square test was used to compare the qualitative variables of groups (Manager group & workers), The study revealed musculoskeletal, gastrointestinal, renal, dermatological, and respiratory symptoms were detected, the exposed group had a lower level of Mean Corpuscular haemoglobin (MCH), Haemoglobin (Hb), Haematocrit (HCT), and Red blood cell (RBC) than the control group. However, results revealed that 69% had negative attitudes, 73% had unsafe practices and 64% had unsatisfactory knowledge.

In addition, a study was conducted to describe municipal workers in Alexandria (Egypt)regarding health practices and safety measures and work-related ill health. Two groups were used for data collection, one exposed group and the other nonexposed group, Interview were conducted from 346 workers. The study exhibits inadequate protective and safety measures & hazardous exposure, workers in the exposed group of solid wastehandlers increased risk of ill health (Abd El-Wahab et al., 2014).

Another study was conducted in Malaysia by (Al-Naggar et al., 2019) to inspect the knowledge, attitude and practice of community consciousness about domestic waste management. A cross-sectional study was performed, and data were analyzed on SPSSversion 22, using T-test, ANOVA and Chi-squared, a total of 355 respondents contributed to the study. In domestic waste management knowledge, attitude and practice of participants greatly influence education, income, occupation, religion and ethnicity. A massive majority showed inappropriate waste management causes leptospirosis (98%) and dengue fever (97.2%).

Methodology

The research was conducted in Hyderabad, Pakistan involving 384 solid waste collectors. It used a cross-sectional quantitative design with Primary data collected via questionnaires from Sindh Solid Waste Management Board workers with convenient sampling technique. Reliability of questionnaire of KAP shown Cronbach's alpha 0.786 this indicate that this studyis reliable and acceptable. Using SPSS version 22 for Statistical analyses included Inferential statistics, *t*-tests, one-way ANOVA and Post Hoc test was conducted for Multiple comparisonsamong groups. Study Population Sindh solid waste management board (SSWMB), Hyderabad.

Result

Socio-Demographic Characteristics

Here is an in-depth look at the socio-demographic characteristics of the 384 solid wastecollectors who participated in the study. Males made up the entire participant group, accounting for 100% of the sample. In terms of age distribution, the majority of respondents were between the ages of 36 and 45, accounting for 38 percent of the total,with the age group 26-35 accounting for 37.2 percent.

Table 1: Socio-Demographic characteristics of solid waste collectors

Characteristics	Frequency (n=384)	Percent
Gender		
Male	384	100
Age		
≤25	32	8.3
26-35	143	37.2
36-45	146	38
≥46	63	16.4
Marital Status		
Single	34	8.9
Married	349	90.9
Divorced	1	0.3
Residence		
Urban	196	51
Rural	188	49

Knowledge of Workers towards Hazards Exposure

Table 2 displays information about respondents' knowledge about solid waste hazards.The data in Table 2 below provide valuable insights into respondents' knowledge and awareness of solid waste management and associated hazards. It is clear that a significant proportion of respondents, approximately 44 percent, claimed to be knowledgeable about solid waste management. While the majority,55.7 percent, admitted to being unaware, with a negligible 0.3 percent remaining unsure. Furthermore, the survey found that 86.2 percent of participants were aware of the dangers associated with solid waste, while 13.8 percent were unaware.

Table 2: Knowledge of workers towards hazards exposure
(Kasemy et al., 2021b)

S #	Question	Yes		No		Not sure	
		n	%	n	%	n	%
1	Do you have idea about solid wastemanagement?	169	44	214	55.7	1	0.3
2	Is there any hazard associated withsolid wastes?	331	86.2	53	13.8		
3	Is needle stick/sharp injury aconcern?	354	92.2	30	7.8		
4	Does wearing personal protectiveequipment (gloves, marks, boots,and aprons) reduce the risk of infection	379	98.7	5	1.3		
5	Are all solid wastes hazardous?	306	79.7	78	20.3		
6	Do you know colour codingsegregation of solid wastes?	33	8.6	351	91.4		
7	Should infections waste containersbe a label with biohazard symbol?	290	75.5	94	24.5		
8	Should solid wastes be segregated atthe source?	290	75.5	93	24.2	1	0.3
9	Does disinfection of solid wastesdecrease infection transmission?	288	75	96	25		
10	Do we need to close solid care wastecontainers while in transport?	304	79.2	80	20.8		
11	Do you know about solid care wastedisposal methods?	149	38.8	235	61.2		

*number of respondents

Notably, 92.2 percent of respondents expressed concern about needle injury or sharp injury caused by solid waste, emphasizing the importance of safety measures. In termsof safety precautions, 98.7 percent of respondents agreed that wearing personal protective equipment (PPE) such as gloves, masks, boots and aprons reduces the risk of infection. In comparison, only 1.3 percent agreed with this statement. Furthermore, respondents' perceptions of whether all solid waste is hazardous varied with approximately 79.7 percent believing they are hazardous, while the remaining 20.3 percent disagreed. In comparison, only 1.3 percent agreed with this statement. Furthermore, respondents' perceptions of whether all solid wastes are hazardous varied, with approximately 79.7 percent believing they are hazardous, while the remaining 20.3percent disagreed.

The understanding of color coding for solid waste segregation emerged as a significantknowledge gap, with only 8.6 percent of respondents familiar with the concept, leaving
91.4 percent in the dark. A significant 75.5 percent agreed with the practice of labellinginfectious waste containers with a biohazard symbol, while 24.5 percent disagreed. Similarly, 75.5 percent agreed that solid waste should be separated at the sources, while
24.2 percent disagreed and 0.3 percent expressed uncertainty.

Regarding the effectiveness of disinfection in reducing infection transmission, 75 percent of respondents agreed, while 25 percent disagreed. In contrast, views on the necessity of closing solid waste containers during transportation were more evenly divided, with 79.2 percent favoring closure and 20.8 percent opposing it. Finally, the survey revealed a lack of knowledge among respondents regarding solid waste disposal methods, with only 38.8 percent reporting being informed, while the

majority, comprising 61.2 percent, admitted to being unaware.

Finally, the findings highlight the importance of targeted educational initiatives and awareness campaigns to bridge knowledge gaps and promote safe solid waste management practices, particularly in areas such as color coding, waste segregation and disposal methods. The survey findings provide a solid foundation for improving safety measures and knowledge dissemination in this critical domain.

Attitude of Workers towards Hazards Exposure

Table 3 shows respondents' attitudes towards solid waste hazards in the context of theirjobs. This table provides useful information about workers' perceptions and attitudes towards safety precautions. The role of solid waste management and their understanding of infectious disease transmission through waste.

These high percentages indicate a strong understanding of the importance of PPE injury prevention. The respondents also expressed favorable attitudes towards hygiene and health. A whopping 97.4% agreed that taking a shower after work can help reduce diarrheal diseases and refresh the mind. Furthermore, 97.9 percent believed that wearing clean clothes can help prevent dermal diseases. These responses demonstrate a thorough understanding of the role of personal hygiene in the prevention of health problems.

The majority of respondents recognized the importance of proper solid waste management. A sizeable 95.3percent thought it was a problem and 98.7 percent thoughtsafe solid waste management necessitated collaboration. Furthermore, 93.8 percent agreed that solid waste should be segregated at the source, and 89.6 percent believed that segregation facilities safe handling. These responses indicate a favorable attitudetoward environmentally responsible waste management practices. Respondents demonstrate varying levels of knowledge and attitudes toward disease transmission viasolid waste.

While 81.8 percent were aware that HIV can be transmitted through solid waste, only

69.8 percent were aware that HBV could be transmitted through solid waste. Surprisingly, 49.2 percent believed that solid waste did not spread infectious diseases. This finding emphasizes the importance of educating and raising awareness about the potential health risks associated with solid waste.

The majority of respondents (96.1percent) agreed that proper solid waste disposal can prevent infection transmission and 93.5 percent believed that solid waste disinfection can reduce the chances of contracting infections. In terms of government initiatives, only 6% thought the government was doing enough to protect and protect workers' health, while the vast majority (94%) disagreed. This reflects a widespread belief among workers that the government should do more to protect their health and well- being 94.3 percent of respondents agreed that solid waste additional responsibilities associated with proper waste management, but they may be overwhelmed by the workload.

In conclusion, Table 3 provides valuable insights into workers' attitudes and perceptions of solid waste hazards and management. While the importance of PPE, hygiene and proper waste management is widely acknowledged, there are gaps in knowledge regarding disease transmission through waste. Respondents also expresseda desire for more government assistance in safeguarding their health and safety. Thesefindings can be used to develop targeted interventions and training programs to improveworkers' knowledge and attitudes about solid waste management and safety.

Table 3: Attitude of workers towards hazards exposure
(Kasemy et al., 2021b)

S #	Question	Yes		No		Not sure	
		n	%	n	%	n	%
1	Do you know wearing glove canreduce damage to your hand?	379	98.7	5	1.3		
2	Do you wearing mask can reducedamage to respiratory organs?	380	99	4	1		

3	Do you aware wearing rubber bootscan reduce damage to feet?	376	97.9	8	2.1		
4	Do you know wearing apron canreduce physical damage to body?	369	96.1	14	3.6	1	0.3
5	Having shower after work reducediarrheal diseases?	374	97.4	10	2.6		
6	Having shower after work help torefresh mind?	374	97.4	10	2.6		
7	Do you aware working with clean cloth can prevent dermal diseases?	376	97.9	8	2.1		
8	Do you agree changing cloth afterwork gives you aesthetical satisfaction?	377	98.2	7	1.8		
9	Does proper solid waste handling isan issue?	366	95.3	18	4.7		
10	Does safe solid waste managementneed a teamwork?	379	98.7	5	1.3		
11	Do You aware, HIV can be transmitted through solid wastes?	314	81.8	69	18	1	0.3
12	Do you aware HBV can be transmitted through solid wastes?	268	69.8	116	30.2		
13	Does solid wastes do not transmitany infection diseases?	189	49.2	195	50.8		
14	Do you agree solid waste should besegregation at the point of generation?	360	93.8	24	6.3		
15	Do you agree solid waste segregation can facilitate safehandling	344	89.6	40	10.4		
16	Do you agree proper solid wastesdisposal can prevent infection transmission?	369	96.1	15	3.9		
17	Do you know sold waste disinfections can reduce the chanceof contracting the infections?	359	93.5	25	6.5		
18	Do you agree solid waste management add the extra burdenof work?	362	94.3	22	5.7		
19	Do you agree infections medicalwaste should be disinfections before disposal?	355	92.4	29	7.6		
20	Do you feel that Government isdoing enough towards workers protection and health?	23	6	361	94		

*number of respondents

Practice of solid waste collectors towards safety measures

Table 4 provides valuable insights into the respondents' hygiene practices, safety measures and workplace behaviors. These practices are critical for ensuring workers'health and well-being, especially in environments where hazards are present.

According to Table 4, the vast majority of respondents prioritize hygiene. An impressive 99.2 percent of them reported using soap to wash their hands after work, demonstrating a strong commitment to cleanliness. Similarly, 99.7 percent said they take a shower after work, highlighting the importance of personal hygiene in their routine. Furthermore, 97.9 percent change their work clothes after work, indicating a deliberate effort to limit the spread of contaminants. The high proportion (99.2 percent)of those who wash their work clothes after use demonstrates their commitment to hygiene. A notable finding is that 75% of respondents share

work clothes with their co- workers, while the remaining 25% do not. Sharing work clothes can have an impact onhygiene, potentially increasing the risk of contamination among employees. This aspect should be given more thought to workplace safety policies.

According to the data, a sizeable proportion (97.1 percent) of respondents consume food at work. This practice has implications for food safety and hygiene standards, emphasizing the need for strict guidelines and monitoring to ensure worker safety. Pre-employment training was reported by nearly all respondents (98.7 percent). This training most likely covers various aspects of workplace safety and hygiene, which contributes to the respondents' positive hygiene practices. It is critical to continue providing such training to maintain and improve workplace safety. Surprisingly, only
42.7 percent of respondents reported using personal protective equipment regularly (PPE). This finding raises concerns about workplace safety and the importance of promoting consistent PPE use to reduce the risk of occupational hazards. Employees should prioritize worker safety by encouraging them to wear PPE regularly.

Finally, Table 4 highlights respondents' positive hygiene practices, particularly handwashing, showering and changing work clothes. However, the practice of sharingwork clothes and eating at the workplace raises important hygiene and safety concerns. Pre-employment training appears to be critical in promoting these positive behaviors.The lower percentage of respondents who frequently use PPE emphasizes the importance of reinforcing workplace safety measures. Overall, these findings highlight the importance of ongoing efforts to maintain and improve worker hygiene and safety standards to protect their health and well-being.

Table 4: Practices of solid waste collectors towards safety measure
(Kasemy et al., 2021b)

S #	Question	Yes		No		Not sure	
		n	%	n	%	n	%
1	Do you wash hand with soapafter work?	381	99.2	3	0.8		
2	Do you take a shower after work?	383	99.7	1	0.3		
3	Do you change work clothes afterwork?	376	97.9	8	2.1		
4	Do you wash work clothe afterwork?	381	99.2	3	0.8		
5	Do you share work clothes withcolleague?	288	75	96	25		
6	Do you Eating food atworkplace?	273	97.1	11	2.9		
7	Do you Received pre-employment training?	379	98.7	5	1.3		
8	Do you frequently use of personal protective equipment?	164	42.7	220	57.3		

*number of respondents

Data Analysis and InterpretationResidence

The table below exhibits, to calculated independent variable residence of rural and urban areas t-test was documented. The First one displays equal variance second groupdepicts unequal variance. On the left-hand side, we analyses Levine's test of equality variance and similarly, on the other hand, we assume the t-test for equality of means. The two groups in Leven's test showed a significance level revealed a small value of less than 0.05, the null hypothesis was false. This depicts two groups that don't have equal variance and difference between urban & rural areas. Now we used the t-test for Equality of means associated with unequal variance.

If two groups were self-efficacy two-tail test was less than 0.05 therefore we accepted the alternative hypothesis and rejected the null hypothesis. The outcome of the unequal variance t-test showed t statistics -6.842 and the degree of freedom was 370.844. Then at a 5% level of significance, the p-value (two-tailed) was less than <.001. The self-efficacy means of rural (M=47.2500, SD =3.87316) was more excessive than the mean of urban (M=44.7041, SD=3.39142). Differences in magnitude were noted =-2.54592, 95%CI:-3.27766 to -1.81418.

Table 5: Group Statistics KAP

Residence	N	Mean	Std. Deviation	Std. Error Mean
Urban	196	44.7041	3.39142	.24224
Rural	188	47.2500	3.87316	.28248

Table 5.1: Independent Sample Test

INDEPENDENT SAMPLES TEST									
Levene's Test for Equality of variance						t-test for Equality of Means		Interval of the Difference	
	F	Sig	t	df	Sig.(2-tailed)	Mean Difference	Std.Error Difference	Lower	Upper
KAP Equal variances assumed	9.462	0.002	-6.860	382	<.001	-2.54592	0.37110	-3.27557	-1.81626
Equal variances not assumed			-6.842	370.84	<.001	-2.54592	0.37212	-3.27766	-1.81418

Gender

T-test and one-way ANOVA is unable to be performed because they contain one group all respondent is male therefore for t-test requires two groups and ANONArequire multiple groups.

Age group and knowledge towards hazards exposure of solid waste collectors

The descriptive Table 5 shows mean of the age group <25 (M=16.1825, SD=2.30620)is different significantly from the age group of 26-35 (M=15.2308, SD=2.32770). 36-45 age group (M=14.1712, SD=.51440) is significantly difference from >45(M=12.5714, SD=1.10229). Respondents of the age group <25 showed a higher rating score (m=16.1825). The Analysis of variance one-way in Table 6.1 ANOVA result exhibits that there is a significant difference in knowledge and age group of Solidwaste collectors ($F_{3,380}$= 27.437, p =<.001). Statically significant is considered when the p-value is less than 0.05.

Table 6: Descriptive

					95% Confidence Interval for mean	
Knowledge	N	Mean	St. Deviation	St. Error	LowerBound	UpperBound
<25	32	16.1875	2.30620	.40768	15.3560	17.019
26-35	143	15.2308	2.32770	.19465	14.8460	15.6156
36-45	146	14.1712	2.51440	.20809	13.7599	14.5825
>45	63	12.5714	1.10299	.13896	12.2936	12.8492
Total	384	14.4714	2.47372	.12624	14.2232	14.7196

Table 6.1: Shown One-Way ANOVA Age Group Knowledge towards Hazards Exposureof Solid Waste Collectors

ANOVA
Knowledge

	Sum of squares	df	Mean square	F	Sig
Between Groups	417.278	3	139.093	27.437	<.001
Within Groups	1926.407	380	5.069		
Total	2343.685	383			

Post Hoc Test and Multiple comparisons

Table 6.2 Illustrate Multiple comparisons were conducted to know which specific groupis different, post hoc test showed no significant difference was recorded in knowledgebetween the age group less than 25 and between 26-35 age group (p=.201), however, the age group less than 25 and between 36-45 shown significant difference (p =<.001) . similarly, age group between <25 and >45 revealed statistically significant(p=<.001) as well as age group between 26-35 and between 36-45 exhibits significant difference (p =.001), age group between 26-35 and more than 45 revealed significant difference (p =<.001). In addition to age group between 36-45 and more than 45 was statically significant (p =<.001).

Table 6.2: Post HOC TestsMultiple comparisons

					95% Confidence Interval	
(I)Age	**(J)Age**	**Mean difference (I-J)**	**St. Error**	**Sig.**	**LowerBound**	**UpperBound**
<25	26-35	.95673	.45177	.210	-.2821	2.1956
	36-45	2.01627*	.45772	<.001	.7636	3.2689
	>45	3.61607*	.43072	<.001	2.4248	4.8073
Between 26-35	<25	-.95673	.45177	.210	-2.1956	.2821
	36-45	1.05954*	.28494	.001	.3048	1.8142
	>45	2.65934 *	.23917	<.001	2.0242	3.2945
Between 36-45	<25	-2.01627*	.45772	<.001	-3.2689	-.7636
	26-35	-1.05954*	.28494	.001	-1.8142	-.3048
	>45	1.59980*	.25023	.001	.9354	2.2642
>45	<25	-3.61607*	.43072	<.001	-4.8073	-2.4248
	26-35	-2.65934*	.23917	<.001	-3.2945	-2.0242
	36-45	-1.59980*	.25023	<.001	-2.2645	-.9354

***** The mean difference is significant at the 0.05 level

Age group and attitude towards hazards exposure of solid waste collectors

All four-age group exhibits different means in Table 7. Age group between 26-35 (M=22.8112, SD=1.95351) shown higher attitude towards age group 36- 45(M=22.7466, SD= 1.96104), <25(M= 22.1813, SD=1.25040) and >45 (M=21.7937, SD=1.0343) Difference in attitude exhibits in descriptive table below. Respondent agegroup 26-35 exhibits a higher rating (m=22.8112). The ANOVA chart in Table 4.12 below shows the consequence of the attitude of solid waste collectors which revealed that there is a significant difference between different age groups (F3,380=5.580, p=<.001).

Table 7: Descriptive

					95% Confidence Interval for mean	
Attitude	**N**	**Mean**	**St. Deviation**	**St. Error**	**LowerBound**	**UpperBound**
<25	32	22.1813	1.25040	.22104	21.8304	22.7321
26-35	143	22.8112	1.95351	.16336	22.4883	23.1341
36-45	146	22.7466	1.96104	.16230	22.4258	23.0673
>45	63	21.7937	1.03423	.13030	21.5332	22.0541
Total	384	22.5755	1.81940	.09285	22.3930	22.7581

Table 7.1: ANOVA
Attitude

	Sum of squares	**df**	**Mean square**	**F**	**Sig**
Between Groups	53.498	3	17.833	5.580	<.001
Within Groups	1214.312	380	3.196		
Total	1267.810	383			

Post Hoc test and Multiple comparisons

Table 7.2 illustrate Post hoc test attitude and age group less than 25 and between 26-35(p = .296), 36-45 and less than 25 (p = .440), less than 25 and more than 45(p = .315)indicate all have no statistically significant. Similarly, the age group between 26-35 and36-45 expressed no statistically significant (p = 1.000). However, the age group between 26-35 and more than 45 was revealed statistically significant (p =<.001) as well and the age group from 36-45 and more than 45 was shown statically significant (p =<.001).

Table 7.2: Post HOC Tests
Multiple comparisons
Attitude

					95% Confidence Interval	
(I)Age	**(J)Age**	**Mean difference (I-J)**	**Std. Error**	**Sig.**	**LowerBound**	**UpperBound**
<25	26-35	-.52994	.27486	.296	-1.2732	.2133
	36-45	-.46533	.27423	.440	-1.2070	.2764
	>45	.48760	.25659	.315	-.2122	1.1874
Between 26-35	<25	.52994	.27486	.296	-.2133	1.2732
	36-45	.06461	.23028	1.000	-.5453	.6745
	>45	1.01754*	.20896	<.001	.4624	1.5726
Between 36-45	<25	.46533	.27423	.440	-.2764	1.2070
	26-35	-.06461	.23028	1.000	-.6745	.5453
	>45	.95292*	.20813	<.001	.4001	1.5058
>45	<25	-.48760	.25659	.315	-1.1874	.2122
	26-35	-1.01754*	.20896	<.001	-1.5726	-.4624
	36-45	-.95292*	.20813	<.001	-1.5058	-.4001

***The mean difference is significant at the 0.05 level.

Age group and practice towards safety measure of solid waste collectors

The descriptive table 8 practice of age group indicates different means. Mean of age group <25 (M=8.8750, SD=.60907) is changed from age group 26-35(M=8.9971, SD=.52025),35-45 age group (M=8.9110, SD=.76943) and >45 (M=8.8254, SD=.
583090. Respondents between the ages of 26-35 express higher scores in rating (m=8.9371). The outcome of ANOVA in Table 8.1 practice of solid waste collectors displays a significance value is more than 0.05($F_{3,380}$=.468, p=.705). Therefore, the practice of solid waste collectors is not statistically significant.

Table 8.2 Post hoc and multiple comparison Practice of age group less than 25 and between 26-35 (p=.995), similarly age group 36-45 and less than 25 appear (p=1.000)as well as age group more than 45 and less than 25 (p=.999) exhibit statistically non-significant. Similarly, the age group 26-35 and 36-45 (p=1.000) as well as the age group26-35 and more than 45 (p=.719) along with age group 36-45 and more than 45 (p=.942) were insignificant.

Table 8: Descriptive

					95% Confidence Interval for mean	
Practice	**N**	**Mean**	**St. Deviation**	**St. Error**	**Lower Bound**	**Upper Bound**
<25	32	8.8750	.60907	.10767	8.6554	9.0946
26-35	143	8.9371	.52025	.04351	8.8511	9.0231
36-45	146	8.9110	.76943	.06368	8.7851	9.0368
>45	63	8.8254	.58309	.07346	8.6785	8.9722
Total	384	9.9036	.64114	.03272	8.8393	8.9680

Table 8.1: ANOVA
Practice

	Sum of squares	df	Mean square	F	Sig
Between Groups	.579	3	.193	.468	.705
Within Groups	156.855	380	.413		
Total	157.435	383			

Table 8.2: Post Hoc TestsMultiple comparisons

					95% Confidence Interval	
(I)Age	**(J)Age**	**Mean difference (I-J)**	**St. Error**	**Sig.**	**LowerBound**	**UpperBound**
<25	26-35	-.06206	.11613	.995	-.3819	.2578
	36-45	-.03596	.12509	1.000	-.3767	.3048
	>45	.04960	.13034	.999	-.3044	.4036
Between 26-35	<25	.06206	.11613	.995	-.2578	.3819
	36-45	.02610	.07712	1.000	-.1783	.2305
	>45	.11167	.08538	.719	-.1170	.3403
Between 36-45	<25	.03596	.12509	1.000	-.3048	.3767
	26-35	-.02610	.07712	1.000	-.2305	.1783
	>45	.08556	.09722	.942	-.1734	.3445
>45	<25	-.04960	.13034	.999	-.4036	.3044
	26-35	-.11167	.08538	.719	-.3403	.1170
	36-45	-.08556	.09722	.942	-.3445	.1734

***The mean difference is significant at the 0.05 level.

Marital status and knowledge towards hazards exposure of solid waste collectors Table 9 shows mean of the Single age group is more knowledgeable (M=15.0882, SD=2.36602) as compared to married (M=14.4126, SD=2.48246) & divorced (M=14.0000). Table 4.15 significance value ($F_{2,381}$=1.175, p=.310) is higher than 0.05 so there is no significant difference in means of single, married and divorced groups.

Table 9: Descriptive

					95% Confidence Interval	
Knowledge	**N**	**Mean**	**St. Deviation**	**St. Error**	**LowerBound**	**UpperBound**
Single	34	15.0882	2.36602	.40577	14.2627	15.9138
Married	349	14.4126	2.48246	.13288	14.1513	14.6740
Divorced	1	14.0000				
Total	384	14.2714	2.47372	.12624	14.2232	14.7196

Table 9.1: ANOVA
Knowledge

	Sum of squares	**df**	**Mean square**	**F**	**Sig**
Between Groups	14.365	2	7.183	1.175	.310
Within Groups	2329.320	381	6.114		
Total	2343.685	383			

Note: Marital status Post hoc tests of knowledge are not performed because one group has at least fewer than two cases.

Marital status and attitude towards hazards exposure of solid waste collectors
The descriptive Table 10 exhibits Single group attitude means (M=23.6765, SD=2.43361) are more than married (M=22.4699, SD= 1.71784) and divorced group. The ANOVA table 10.1 reflects there is a significant difference between marital status and attitude of Solid waste collectors sig. value is <.001 less than 0.05($F_{2,381}$=7.081, p=<.001).

Table 10: Descriptive

					95% Confidence Interval for mean	
Attitude	**N**	**Mean**	**St. Deviation**	**St. Error**	**LowerBound**	**UpperBound**
Single	34	23.6765	2.43361	.41736	22.8273	24.5256
Married	349	22.4699	1.71784	.09195	22.2891	22.6508
Divorced	1					
Total	384	22.5755	1.81940	.09285	22.3930	22.7581

Table 10.1: ANOVA
Attitude

	Sum of squares	**df**	**Mean square**	**F**	**Sig**
Between Groups	45.435	2	22.717	7.081	<.001
Within Groups	1222.375	381	3.208		
Total	1267.810	383			

Note: Marital status Post hoc tests of attitude are not performed because one group has at least fewer than two cases.

Marital status and practice towards safety measure of solid waste collectors

Descriptive Table on 11 below exhibits divorced group mean is higher (M=9.0000) than Married (M=8.9140, SD=.65086) and single (M=8.7941, SD=.53820). However, the divorced group revealed higher practice as compared to single and married groups.

Table 11.1 P-value is .576 is higher than 0.05($F_{2,381}$=.552, p=.576) and is not statically significant.

Table 11: Descriptive

					95% Confidence Interval for mean	
Practice	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**LowerBound**	**UpperBound**
Single	34	8.7941	.53820	.09230	8.6063	8.9819
Married	349	8.9140	.65086	.03484	8.8455	8.9826
Divorced	1	9.0000				
Total	384	8.9036	.64114	.03272	8.8393	8.9680

Table 11.1: ANOVA

Practice

	Sum of squares	**df**	**Mean square**	**F**	**Sig**
Between Groups	.455	2	.227	.552	.576
Within Groups	156.980	381	.412		
Total	157.435	383			

Note: Marital status Post hoc tests of practice are not performed because one group has at least fewer than two cases.

Conclusion

This research paper provides a thorough examination of workers' solid waste management and workplace safety knowledge, attitudes, and practices. The research reveals a diverse landscape, with workers displaying varying levels of awareness and comprehension. While many people are aware of general hazards, needle stick injuries, and the importance of personal protective equipment (PPE), there are significant gaps, particularly in waste segregation and complex disposal methods. Workers are generallypositive about the effectiveness of PPE, but they are concerned about the additional workload associated with solid waste management. There is a growing awareness of the potential transmission of infectious diseases through solid waste, which is encouraging. Although the study highlights commendable hygiene practices such as handwashing, showering, and changing work clothes, it does raise some concerns about sharing clothes among colleagues and workplace food consumption. To address these findings, recommendations emphasizing education and training, consistent PPE use, policy development, awareness campaigns, and government involvement are proposed.In essence, this study emphasizes the importance of bridging knowledge gaps and improving safety practices to create a safer and healthier environment for solid waste management workers, benefiting both the workforce and the larger community.

As per policies, Pre-employment three days of training was provided to solid waste collectors but this training was insufficient. Personal protective equipment like a dust mask, safety goggles, and ear plugs are not provided regularly as well and safety shoes,hand gloves, safety helmets and coveralls are provided once till one year before when SSWMB start operation also lack of equipment is recorded in collection and disposal of solid waste.

For gender-independent sample t-test and one-way ANOVA were not performed because all are male respondents, for t-test two groups are necessary and

for ANOVA multiple groups are necessary to perform.

An independent *t*-test was conducted on the residents of rural and urban areas which showed a statistically significant between urban and rural areas although rural areas hada higher mean score, this proved that urban had more knowledge, attitude and practicethan urban. This shows that the knowledge, attitude and practice of rural and urban areas are different.

One-way ANOVA was performed results exhibit that there is a significant difference in knowledge and attitude of all age groups about hazardous exposure of Solid waste collectors. However, safety measure practice is insignificant in all age groups. Marital status and knowledge of solid waste collectors show no difference, all have similar knowledge, although marital status and attitude of solid waste collectors exhibits statistically significant. Marital status and safety practices of solid waste collectors revealed no statistically significant. Marital status Post hoc tests of knowledge, attitudeand practice are not performed because one group has at least fewer than two cases.

Future Research Direction

This study is limited to Sindh Solid Waste Management Board (SSWMB) solid waste collectors. However, here are many areas that which are needed to study for future research such as Sindh Solid Waste Management Board (SSWMB) sweepers and Hyderabad Municipal Corporation sanitary workers.

References:

Abd El-Wahab, E. W., Eassa, S. M., Lotfi, S. E., El Masry, S. A., Shatat, H. Z., & Kotkat, A. M. (2014). Adverse health problems among municipality workers in alexandria (egypt). *International Journal of Preventive Medicine*, *5*(5), 545–556.www.ijpm.ir

Al-Naggar, R. A., Abdulghani, M. A. M., & Al-Areefi, M. A. (2019). Effects of inappropriate waste management on health: Knowledge, attitude and practice

among Malaysian population. *Malaysian Journal of Public Health Medicine*,*19*(1), 101–109.

Albritton, D. L., & Kuijpers, L. (1999). Synthesis of the reports of the Scientific, Environmental Effects, and Technology and Economic Assessment Panels of the Montreal Protocol: a decade of assessments for decision makers regarding the protection of the ozone layer: 1988-1999. In *Assessment*. http://books.google.com/books?hl=en&lr=&id=sLlIa0FdRUkC&oi=fnd&pg=PR7&dq=Synthesis+of+the+Reports+of+the+Scientific+,+Environmental+Effects+,+and+Technology+and+Economic+Assessment+Panels+of+the+Montreal+Protocol+A+Decade+of+Assessment

Ali, M., Ashraf, U., Chaudhry, N., & Geng, Y. (2017). Unsafe waste management practices and Hepatitis C among hospital sanitary staff in Pakistan Unsafe waste management practices and hepatitis C among hospital sanitary staff in Pakistan.*Journal of Hospital Infection*, *96*(1), 95–96. https://doi.org/10.1016/j.jhin.2017.03.017

Ali, M., Wang, W., Chaudhry, N., & Geng, Y. (2017). Hospital waste management in developing countries: A mini review. *Waste Management and Research*, *35*(6), 581–592. https://doi.org/10.1177/0734242X17691344

Cabrera-Ormaza, M. V. (2018). *International Labour Organization*. 227–249. https://doi.org/10.1007/978-981-10-5206-4_26

Cointreau, S. (2006). Occupational and environmental health issues of solid wastemanagement. *Urban Papers*, *August*, 57.

Drda, B., Gomez, J., Conroy, R., Seid, M., & Michaels, J. (2002). San Francisco Safe Needle Disposal Program, 1991-2001. *Journal of the American Pharmaceutical Association (Washington, D.C.: 1996)*, *42*(6 Suppl 2), S115–S116. https://doi.org/10.1331/1086-5802.42.0.s115.drda

Elmubarak, A., Elhassan, N., Fadl, K., & Alzain, M. (2021). Occupational Risks among the Municipal Solid Waste Collectors in Khartoum Locality. *Ijmrap.Com*,

3(11), 41–45.

Gebremedhin, F. (2016). Assessment of Knowledge, Attitude and Practices Among Solid Waste Collectors in Lideta Sub-city on Prevention of Occupational Health Hazards, Addis Ababa, Ethiopia. *Science Journal of Public Health*, *4*(1), 49. https://doi.org/10.11648/j.sjph.20160401.17

Hämäläinen, P., Takala, J., & Saarela, K. L. (2006). Global estimates of occupationalaccidents. *Safety Science*, *44*(2), 137–156. https://doi.org/10.1016/j.ssci.2005.08.017

Hamid, A., Saleem, W., & Yaqub, G. (2019). *Comparative assessment of respiratoryand other occupational health effects among elementary workers*. *3548*. https://doi.org/10.1080/10803548.2017.1393161

Jerie, S. (2016a). Occupational risks associated with solid waste management in theinformal sector of

Gweru, Zimbabwe. *Journal of Environmental and Public Health*, *2016*. https://doi.org/10.1155/2016/9024160

Jerie, S. (2016b). Occupational risks associated with solid waste management in theinformal sector of Gweru, Zimbabwe. *Journal of Environmental and Public Health*, *2016*. https://doi.org/10.1155/2016/9024160

Kasemy, Z. A., Rohlman, D. S., & Abdel Latif, A. A. (2021a). Health disorders among Egyptian municipal solid waste workers and assessment of their knowledge, attitude, and practice towards the hazardous exposure.

Environmental Science and Pollution Research, *28*(24), 30993–31002. https://doi.org/10.1007/s11356-021-12856-3

Kasemy, Z. A., Rohlman, D. S., & Abdel Latif, A. A. (2021b). Health disorders among Egyptian municipal solid waste workers and assessment of their knowledge, attitude, and practice towards the hazardous exposure.

Environmental Science and Pollution Research, *28*(24), 30993–31002. https://doi.org/10.1007/s11356-021-12856-3

Kuijer, P. P. F. M., & Frings-Dresen, M. H. W. (2004). World at work: Refuse collectors. *Occupational and Environmental Medicine*, *61*(3), 282–286. https://doi.org/10.1136/oem.2002.001172

Newcomb, L. (2016). Pakistan Decent Work Country Programme III. *Ilo*, *5*(7), 1–8.

Olorunnishola, O. A., Kidd-Taylor, A., & Byrd, L. (2010). Occupational injuries and illnesses in the solid waste industry: A call for action. *New Solutions*, *20*(2), 211– 223. https://doi.org/10.2190/NS.20.2.f

Rachiotis, G., Papagiannis, D., Markas, D., Thanasias, E., Dounias, G., & Hadjichristodoulou, C. (2012). Hepatitis B virus infection and waste collection: Prevalence, risk factors, and infection pathway. *American Journal of IndustrialMedicine*, *55*(7), 650–655. https://doi.org/10.1002/ajim.22057

Rogoff, M. J. (2015). Worker safety in solid waste collection. In *MSW Management*
(Vol. 25, Issue 7).

Rushton, L. (2003). Health hazards and waste management. In *British MedicalBulletin* (Vol. 68, pp. 183–197). https://doi.org/10.1093/bmb/ldg034

Sapkota, S., Lee, A., Karki, J., Makai, P., Adhikari, S., Chaudhuri, N., & Fossier- Heckmann, A. (2020). Risks and risk mitigation in waste-work: A qualitative study of informal waste workers in Nepal. *Public Health in Practice*, *1*. https://doi.org/10.1016/j.puhip.2020.100028

Squeri, R., La Fauci, V., Sindoni, L., Cannavò, G., & Ventura Spagnolo, E. (2006).

Study on hepatitis B and C serologic status among municipal solid waste workersin Messina (Italy). *Journal of Preventive Medicine and Hygiene*, *47*(3), 110–113. https://doi.org/10.15167/2421-4248/jpmh2006.47.3.76

Taber, K. S. (2018). The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Tarantola, A., Abiteboul, D., & Rachline, A. (2006). Infection risks following accidental exposure to blood or body fluids in health care workers: A review of pathogens transmitted in published cases. *American Journal of Infection Control*, *34*(6), 367–375. https://doi.org/10.1016/j.ajic.2004.11.011

Thirarattanasunthon, P., Siriwong, W., Robson, M., & Borjan, M. (2012). Health riskreduction behaviors model for scavengers exposed to solid waste in municipal dump sites in Nakhon Ratchasima Province, Thailand. *Risk Management and Healthcare Policy*, *5*, 97–104. https://doi.org/10.2147/RMHP.S30707

Wassiem, A., Zaki, G. R., Charl, F., & El-Gazzar, R. (2021). Biochemical changes among municipal solid waste sorting workers: implications for personal protective equipment availability and use. *International Journal of OccupationalSafety and Ergonomics*, *27*(4), 1028–1038. https://doi.org/10.1080/10803548.2019.1674504

Wath, S. B., Dutt, P. S., & Chakrabarti, T. (2011). E-waste scenario in India, its management and implications. *Environmental Monitoring and Assessment*, *172*(1–4), 249–262. https://doi.org/10.1007/s10661-010-1331-9

World, W. (2010). Solid Waste Management in the World's Cities – Water and Sanitation in the World's Cities 2010. *Management of Environmental Quality:An International Journal*, *21*(6), 869–869. https://doi.org/10.1108/meq.2010.21.6.869.3

Yasobant, S., & Rajkumar, P. (2014). Work-related musculoskeletal disorders among health care professionals: A cross-sectional assessment of risk factors in a tertiary hospital, India. *Indian Journal of Occupational and Environmental Medicine*, *18*(2), 75–81. https://doi.org/10.4103/0019-527