



A Comparative Study on the Knowledge, Attitude, and Perception toward Hazardous Medical Waste Produced at Home in a Coastal City of Karnataka, India

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Abstract

Introduction Hazardous healthcare waste produced at home contributes to approximately 0.5% of biomedical waste, and although potentially infectious, is often discarded with other domestic wastes. The study aimed to quantify and compare types and patterns of biomedical waste generated in homes and to assess the knowledge, attitude, and practices regarding biomedical waste among selected urban and rural households in the coastal area of Mangalore city in Karnataka.

Methods A cross-sectional study was conducted in households consisting of rural and urban field practice areas of a tertiary care hospital in coastal Karnataka from November 2017 to February 2018. A pretested semi-structured questionnaire on knowledge, attitude, and practice regarding healthcare waste generated at home was assessed. Qualitative variables of the waste segregation practice, types of biomedical waste, the knowledge, perception, and attitude to practices regarding biomedical waste were expressed in percentages proportions and analyzed using SPSS v.20.

Results Baby diapers were the most common hazardous waste. The number of baby diapers produced daily in rural and urban areas was 32 (42.7%) and 64 (85.3%), respectively. The urban households had better knowledge of possible hazardous healthcare waste at home, 28 (37.33%) compared with 7 (9.3%) in rural households. Seventy-one (94.7%) urban and 49 (65.3%) rural households had a favorable attitude toward the disposal of hazardous domestic biomedical waste.

Conclusion The knowledge, attitudes, and practices regarding hazardous healthcare waste produced at the household level were better among urban households compared with rural households.

Keywords

- refuse disposal
- medical waste disposal
- condoms
- menstrual hygiene products
- domestic biomedical waste

Introduction

Biomedical waste is generated during the diagnosis, treatment, immunization of human beings or animals, research activities, and/or the production and testing of biologicals.¹

Biomedical waste is mainly produced in hospitals, clinics, nursing homes, veterinary hospitals, and blood banks. Households are typically believed to produce little to no biomedical waste.¹ Because of healthcare requirements, home diagnostic kits for diabetes and pregnancy, non-degradable sanitary

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pads, toilet papers, bandages, baby diapers, and wipes are increasingly being made available to the public, resulting in a notable increase in the amount of hazardous healthcare waste in recent years and are now more commonly produced at houses.² These hazards, though infectious, are discarded without proper disposal along with other domestic wastes.² They can pose a threat by increasing the chance of infection to those who handle the waste and to the environment.

Domestic hazardous healthcare wastes contribute to approximately 0.5% of the entire biomedical waste.^{1,3} A few sources of hazardous healthcare waste produced at home include needles used for testing sugar levels and injecting insulin, urine-soiled bedsheets, expired medicines, used condoms, razor blades, urine pregnancy kits, blood sugar test strips, sanitary pads contaminated with blood, and mercury from a broken sphygmomanometer or thermometer.⁴ Sanitary waste is often used to describe the waste consisting of infant/adult diapers, sanitary napkins/pads, sanitary towels, tampons, and incontinence sheets.⁵ The recent Solid Waste Management Rules that came into effect in 2016, however, have classified only some of these biomedical wastes such as expired medicines, broken mercury thermometers, used needles and syringes, and contaminated gauze as domestic hazardous wastes. On the other hand, the used condoms, sanitary pads, and other absorbent materials used during menstruation have not been considered as biomedical waste.⁶

A study was conducted in Ghana regarding the quantity of hazardous healthcare waste largely produced such as unwanted medicines and sharps and observed that individuals who believed in the notion of improper disposal of healthcare waste were three times more likely to report any waste disposal related injuries.⁷ In one report from Israel, less than 14% of individuals returned unused/expired medications to the health maintenance organization pharmacies.⁸ This study also highlighted that legislative measures for household medical waste disposal play an important role in the appropriate handling of these wastes.⁸ In India, as seen in Israel, no legislation regarding disposal of domiciliary medical waste exists and thus no segregation of waste occurs. The concept of domestic biomedical waste is not widespread in India.⁶ Furthermore, very few studies have been conducted on the quantum and procedures of disposing of domestic wastes. However, the difference between the methods of disposal in urban and rural areas is largely obscure. Therefore, there is an urgent need to investigate the factors contributing to these differences and how these differences could be resolved. This is important in policy decision-making to improve the implementation and consequently reduce the environmental and health hazards of improper domestic biomedical waste disposal in India. The present study aimed to quantify and compare the amount of biomedical waste generated in homes in terms of types and patterns of production among selected urban and rural households. This study also looked into the disparities in waste disposal between urban and rural families, as well as the variables that contribute to these discrepancies. This study also assessed the knowledge, attitudes, and practices

regarding biomedical waste and the perception toward biomedical waste disposal among the selected urban and rural households in a coastal city of Karnataka.

Materials and Methods

Study Setting, Design, and Sample Size

A community-based, cross-sectional study was conducted on selected households residing for more than 6 months in the rural and urban practice areas of a tertiary medical college in coastal Karnataka. The urban practice area caters to a population of ~70,000 and the rural practice area caters to a population of ~2,000 with ~710 households. The study was conducted from November 2017 to February 2018. Purposive sampling of ~150 households (75 rural and 75 urban), based on a study conducted by Bhaskar et al.,⁹ produced ~7,500 kg of hospital biomedical waste in Mangalore city. Meenakshi¹ determined that domestic households produced ~0.5% of the total biomedical waste. Given that an average urban health center caters to 100,000 individuals, which is acquired from the national urban health mission implementation of urban health centers,¹⁰ ~75 houses in rural and urban areas (150 households) were included in the study. The residents who were not available for interviews after three consecutive visits to the community were excluded from the study. The study protocol received approval from the Institutional Ethics Committee and clearance prior to the commencement of the study.

Study Tool

A pretested semi-structured questionnaire containing information on sociodemographic details, knowledge, attitudes, and practices regarding household biomedical waste production and disposal was utilized. The questionnaire contained 13 questions on knowledge. Each question with the correct choice was scored as 1 mark and the rest were scored as 0. The knowledge of the household was scored as good (i.e., score 10 and above), average (7 to 9), and poor (less than or equal to 6). The questionnaire contained 6 questions on attitude and 4 on practice regarding hazardous biomedical waste generated at home. The attitude was scored as favorable when the score was more than 4 and scores less than 3 were scored unfavorable. The practice score was considered poor when the total score was less than or equal to 2 and good when the scores were more than 3. The content validity of the study tool was ascertained after doing a pilot study among rural and urban households and making appropriate changes to the scoring of knowledge-, attitude-, and practice-related questions before the commencement of the main study. In the absence of previous quotable studies on knowledge, attitude, and practice on domestic biomedical waste in India, a scoring pattern, for knowledge, attitude, and practice was developed specifically for this study by the authors.

Statistical Analysis

Data were entered in MS Excel for analysis using SPSS (Statistical Package for Social Sciences) software v.20.

Table 1 Frequency and pattern of hazardous healthcare waste in the population

Sources of hazardous healthcare waste at home	Frequency of production N = 150 (%)					
	Area	Daily	Alternate day	Weekly	Monthly	Rarely/nil
Used pregnancy strip	Rural	0 (0.0)	9 (12.0)	14 (18.7)	20 (26.7)	32 (42.7)
	Urban	4 (5.3)	3 (4.0)	12 (16.0)	3 (4.0)	53 (70.7)
Baby diapers	Rural	32 (42.7)	7 (9.3)	14 (18.7)	16 (21.3)	6 (8.0)
	Urban	64 (85.3)	1 (1.3)	8 (10.7)	0 (0.0)	2 (2.7)
Used razor blades	Rural	1 (1.3)	19 (25.3)	9 (12.0)	38 (50.7)	8 (10.7)
	Urban	10 (13.3)	7 (9.3)	18 (24.0)	30 (40.0)	10 (13.3)
Sanitary pads/menstrual-related material	Rural	0 (0.0)		5 (6.7)	68 (90.7)	2 (2.7)
	Urban				70 (93.3)	0 (0.0)
Used condoms	Rural	0 (0.0)		20 (26.7)	31 (41.3)	24 (32.0)
	Urban			8 (10.7)	25 (33.3)	42 (56.0)
Lancets	Rural	1 (1.3)	7 (9.3)	25 (33.3)	11 (14.7)	31 (41.3)
	Urban		12 (16.0)	27 (36.0)	21 (28.0)	14 (18.7)
Used bandages/dressings	Rural	1 (1.3)	5 (6.7)	3 (4.0)	9 (12.0)	57 (76.0)
	Urban	0 (0.0)		4 (5.3)	6 (8.0)	65 (86.7)
Expired medicines	Rural	0 (0.0)	5 (6.7)	1 (1.3)	21 (28.0)	48 (64.0)
	Urban	0 (0.0)		4 (5.3)	7 (9.3)	64 (85.4)

Note: Values in bold represent the highest percentages.

Qualitative variables of the duration of residence, waste segregation practices, types of biomedical waste, knowledge, perception, and attitude to practices regarding biomedical waste were expressed in percentages and proportions. The association of knowledge, attitude, and practice levels among rural and urban households was determined using the Chi-square test. The factors associated ($p < 0.10$) with each of the domains were subjected to multiple logistic regression after which the significant factors contributing to knowledge, attitude, and practice domains in urban and rural areas were found to be substantial.

Results

General Solid Waste Disposal Practices of Study Populations

In our study, 113 (75.3%) households reported that they disposed of domestic wastes daily; 69 (92.0%) households in urban areas disposed of garbage daily since the waste collection procedure was conducted by the municipal and local authorities. However, in the rural study population, daily disposal of domestic waste was seen in only 44 households (58.7%) and was found to differ significantly from urban households. The presence of garbage collection bins was more common in rural households 69 (92.0%) than urban households 56 (74.7%); this significant difference could be because of more coverage of garbage disposal facilities in urban areas than in rural areas.

Production of Hazardous Healthcare Wastes in Study Populations

The frequency and pattern of production of these hazardous healthcare wastes at home are shown in ►Table 1. The most produced hazardous healthcare waste was baby diapers in rural and urban areas, which were produced daily, i.e., by 32 houses (42.7%) and 64 (85.3) houses, respectively. Hazardous healthcare wastes such as strips for urine pregnancy tests, lancets, bandages/dressings, and expired medicines were produced rarely, whereas sanitary pads/menstrual-related material and used condoms were frequently produced on a monthly basis, which was seen largely in urban areas than in rural areas. In urban settings, the frequency of production of lancets and blades was more common weekly (27 [36.0%]) and monthly (21 [28.0%]) when compared with rural areas which rarely produced lancets (31 [41.3%]).

Knowledge about Hazardous Healthcare Waste Produced at Home

►Table 2 shows the level of knowledge regarding hazardous healthcare waste in urban and rural areas. Approximately 50 (66.7%) households in urban areas knew about hazardous healthcare waste when compared with 29 (38.7%) in rural households. Around 41 (64.1%) of urban households knew that hazardous healthcare waste is perilous, which was much higher than the 23% of rural households (35.9%). The knowledge of biomedical waste disposal was found to be significantly higher among urban households than in rural households (►Table 2). The knowledge regarding sources

Table 2 Knowledge about hazardous healthcare waste (N = 150)

Questions		Frequency n (%)		t-Value	p-Value
		Yes	No		
Heard of hazardous healthcare waste	Rural	29 (38.7)	46 (61.3)	11.794	0.001 ^a
	Urban	50 (66.7)	25 (33.3)		
Knowledge about biomedical waste disposal	Rural	32 (47.8)	43 (51.8)	0.243	0.622
	Urban	35 (52.2)	40 (48.2)		
Hazards associated with improper healthcare waste disposal	Rural	23 (35.9)	52 (60.5)	8.830	0.003 ^a
	Urban	41 (64.1)	34 (39.5)		
Observance of safety precautions when handling hazardous healthcare waste	Rural	18 (24.0)	57 (76.0)	12.45	<0.001 ^b
	Urban	3 (4.0)	72 (96.0)		
Knowledge regarding the following as biomedical waste					
Urine pregnancy strips	Rural	26 (34.7)	49 (65.3)	2.238	0.135
	Urban	35 (46.7)	40 (53.3)		
Baby diapers	Rural	48 (39.3)	27 (36.0)	29.684	<0.001 ^b
	Urban	74 (98.7)	1 (1.3)		
Used razor blades	Rural	37 (49.3)	38 (50.7)	9.108	0.002
	Urban	55 (73.3)	20 (26.7)		
Sanitary pads	Rural	38 (50.7)	37 (49.3)	17.28	<0.001 ^b
	Urban	62 (82.7)	13 (17.3)		
Lancet	Rural	20 (26.7)	55 (66.3)	19.664	<0.001 ^b
	Urban	47 (62.7)	28 (37.3)		
Used bandages	Rural	51 (68.0)	24 (32.0)	0.515	0.473
	Urban	55 (73.3)	20 (26.7)		
Expired medicines	Rural	31 (41.3)	44 (58.7)	9.689	0.002
	Urban	50 (61.7)	25 (33.3)		
Used condoms	Rural	12 (16.0)	63 (84.0)	49.87	<0.001 ^b
	Urban	55 (73.3)	20 (26.7)		

^aChi-square test *p*-value < 0.05.^bFischer's exact test *p*-value < 0.001.

of biomedical waste generated at households was significantly higher among urban households when compared with rural households. The knowledge regarding hazardous biomedical waste produced at home (i.e., baby diapers) was reported by the majority of households 122 (81.3%), and ~106 (70.7%) of households considered sanitary pads and other menstruation-related products as hazardous healthcare waste. In contrast, less knowledge regarding hazardous healthcare waste was found among the study population for items including used pregnancy strips (61 [40.7%]), condoms (67 [44.7%]), lancets/blades (67 [44.7%]), and expired medicines (81 [54.0%]). A significantly higher number of urban households considered used condoms, baby diapers, sanitary pads, and other menstruation-related products and lancets as hazardous healthcare waste when compared with rural households. The urban households had better knowledge regarding possible hazardous healthcare waste at home, i.e., 28 (37.33%) compared with 7 (9.3%) rural households (► Fig. 1).

Attitude toward Disposal of Hazardous Healthcare Waste in Study Populations

As shown in ► Table 3, 70 (93.3%) families in urban areas concurred that it was suitable to utilize an alternate canister to gather the biomedical waste created at home, whereas only 42 (56.0%) families in rural areas agreed with this. In addition, 58 (76.3%) urban households agreed that it was not safe to dispose of hazardous healthcare waste along with domestic garbage as compared with 21 (28.0%) rural households; and ~69 (92.0%) urban households agreed that incorrect disposal was unsafe for the environment and increased the risk of infection as compared with 56 (74.6%) rural households. Overall, 64 (85.6%) urban households believed in the disposal of hazardous healthcare waste if the facilities were provided as compared with 59 (78.7%) rural households. Also, 59 (78.7%) rural and 72 (96.0%) urban households were in favor of adopting the practices of hazardous healthcare waste segregation. As shown in ► Fig. 1, 71 (94.7%) urban households and 49 (65.3%) rural households had a favorable

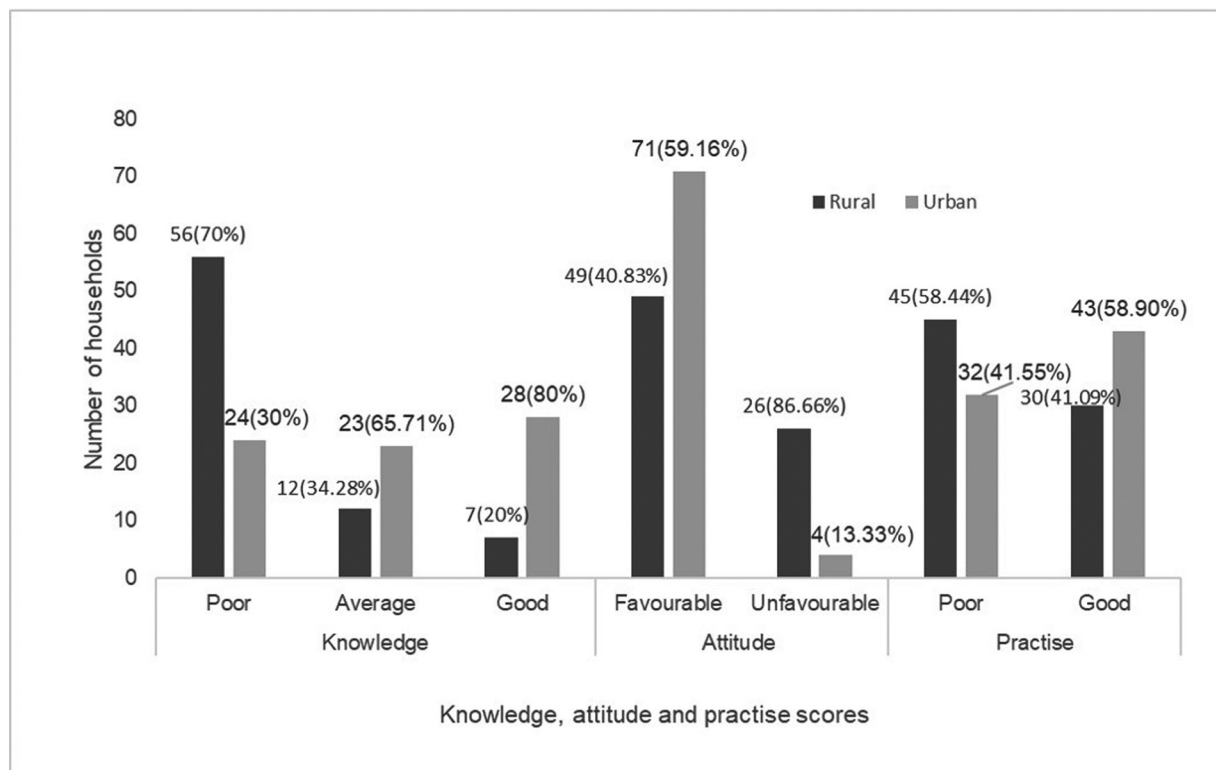


Fig. 1 Comparison of knowledge, attitude, and practice of domestic waste disposal in urban and rural households of the study population.

Table 3 Comparison of attitudes regarding domestic waste disposal in urban and rural households of the study population (N = 150)

Question	Area	Frequency n (%)				
		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Is it appropriate to use a different bin to dispose of hazardous healthcare waste?	Rural	18 (24.0)	24 (32.0)	16 (21.3)	11 (14.7)	6 (8.0)
	Urban	44 (58.7)	26 (34.7)	3 (4.0)	2 (2.7)	0 (0.0)
Is it safe if biomedical waste is disposed of along with garbage?	Rural	17 (22.7)	24 (32.0)	13 (17.3)	13 (17.3)	8 (10.7)
	Urban	3 (4.0)	5 (6.7)	9 (12.0)	37 (49.3)	21 (28.0)
Does incorrect disposal of bio-medical waste make the environment unsafe and other people at risk of infections?	Rural	24 (32.0)	32 (42.7)	13 (17.3)	4 (5.3)	2 (2.7)
	Urban	47 (62.7)	22 (29.3)	3 (4.0)	2 (2.7)	1 (1.3)
Will the availability of facilities to dispose of hazardous healthcare waste help in decreasing hazards associated with improper disposal of hazardous healthcare waste?	Rural	14 (18.7)	39 (52.0)	21 (28.0)	1 (1.3)	0 (0.0)
	Urban	36 (48.0)	28 (37.3)	6 (8.0)	3 (4.0)	2 (2.7)
Is the issue of biomedical waste management significant to you?	Rural	23 (30.7)	36 (48.0)	14 (18.7)	2 (2.7)	0 (0.0)
	Urban	20 (26.7)	35 (46.7)	17 (22.7)		1 (1.3)
If facilities for scientific disposal of domestic waste are made available, will you adopt the practices of hazardous healthcare waste segregation?	Rural	29 (38.7)	30 (40.0)	16 (21.3)	0 (0.0)	
	Urban	49 (65.3)	23 (30.7)	3 (4.0)		

Note: Values in bold indicate the highest percentages.

attitude toward the disposal of hazardous domestic biomedical waste, and the differences in favorable attitudes toward disposal were found to be statistically significant.

Practices of Hazardous Healthcare Waste Collection and Disposal

Around 55 (36.7%) urban and 37 (49.3%) rural households collected and disposed of hazardous healthcare waste separately. Though no significant differences were observed in the use of protective equipment when segregating hazardous healthcare waste, a higher number of urban households (46 [30.7%]) used some protective equipment when disposing of hazardous healthcare waste (► **Table 4**). Good practices concerning domestic medical waste collection and disposal were seen in 43 (57.3%) urban households and 30 (40.0%) rural households; these differences were also found to be statistically significant.

Factors Affecting the Knowledge and Practices regarding Hazardous Household Biomedical Wastes Produced at Home

The regression analysis showed that the knowledge regarding used condoms and diapers was significantly higher among urban households compared with rural households (► **Table 5**). The factors including frequent disposal of solid waste, use of personal protective equipment while handling and disposing biomedical waste at home were found to be significantly associated with urban than rural households.

Discussion

The present study evaluated the knowledge, attitudes, and practices with regard to healthcare wastes produced in urban and rural households of a coastal city of Karnataka. It also compared the practices regarding the domestic

Table 4 Comparison of practices of hazardous healthcare waste production in the study populations ($N = 150$)

Hazardous healthcare waste practice	Frequency n (%)			
	Rural	Urban	t-Value	p-Value
Waste collection practices				
Separate bin for collection and separate disposal of the same	37 (49.3)	55 (36.7)	–	–
Segregate but add with domestic waste	25 (16.7)	20 (13.3)		
No segregation practices followed	13 (8.7)	0 (0.0)		
Presence of waste collection bin	56 (74.7)	69 (92.0)	8.402	0.038*
Frequency of disposing garbage				
Daily	69 (92.0)	44 (58.7)	23.67	<0.001**
Once in 2 days or more	6 (16.2)	31 (41.3)		
Use personal protective equipment when segregating domestic biomedical waste	36 (24.0)	40 (26.7)	0.427	0.514
Use personal protective equipment when disposing of domestic biomedical waste	20 (13.3)	46 (30.7)	18.29	<0.001**

t-value Chi square test. * p -value < 0.05, ** p -value < 0.001.

Table 5 Multiple logistic regression factors affecting knowledge and practices in urban and rural households

Domain	Factors affecting the domains in urban and rural households	Unadjusted t-value	p-Value	Adjusted t-value	p-Value
Knowledge	Heard of hazardous healthcare waste	11.794	0.001	1.542	0.214
Source of biomedical waste	Baby diapers	29.684	<0.001	14.67	<0.001
	Used razor	9.108	0.002	0.47	0.493
	Sanitary pads	17.28	<0.001	1.956	0.162
	Lancets	19.664	<0.001	0.019	0.89
	Used condoms	49.87	<0.001	24.575	<0.001
	Expired medicines	9.689	0.002	0.539	0.463
Practice	Presence of waste collection bins	8.402	0.038	0.552	0.907
	Frequency of disposing garbage	23.67	<0.001	11.494	0.001
	Use of personal protective equipment when disposing domestic biomedical waste	18.29	<0.001	18.06	<0.001

Note: t-value-Pearson's Chi square; p -value < 0.05.

biomedical waste produced in rural and urban households. Our study showed that baby diapers constituted the hazardous waste produced daily in urban and rural households. The hazardous domestic waste produced monthly consisted of used razor blades, sanitary pads, and other menstrual fluid absorbent materials. The urban households had better knowledge, more favorable attitudes, and better hazardous waste handling practices compared with the rural households.

There were significant disparities in waste disposal between urban and rural families, as well as the variables that contributed to these discrepancies. This might be because medical students or healthcare personnel frequently visit urban families and educate them, whereas rural areas have limited access, which could be a contributing factor to the lack of awareness. Furthermore, people in rural areas are frequently less informed about these issues than those in urban areas. In comparison to metropolitan regions, people living in rural areas have limited or no facilities for collecting and disposing of hazardous waste.

A study conducted in Ghana⁷ showed that 80% of the unwanted/discarded medicines and 89% of sharps were disposed of along with solid waste produced at home, of which 23% and 35% of respondents discarded the same without a container. The rates were higher compared with our study where discarded medicines and lancets were produced rarely and ~92 (61.33%) households used separate bins for collection and disposal of biomedical wastes.

Another study from Brazil¹¹ showed that the sharps collected from households constituted $0.02 \pm 0.02\%$ of the waste, whereas non-sharp weights accounted for $5.47 \pm 1.11\%$ of the waste amounting to $5.29 \pm 1.13\%$ of the total solid waste generated at the household level. Pertaining to sharp wastes, razor blades were discernible, whereas among the non-sharps stereotypically included toilet papers, diapers, and sanitary napkins which were in contrast to the study by Meenakshi¹ who estimated the total content to be ~0.5%. This major difference could be because of the ablution habits of these two countries (Brazil and India), as toilet paper ($3.00 \pm 0.9\%$) was the most common domestic biomedical waste produced. In the present study, the most common domiciliary biomedical waste produced was baby diapers, which were produced daily followed by razor blades, sanitary pads/menstrual-related material, and used condoms, which accounted for the monthly waste.

In another study from Guinea,¹² 43.6% of the households did not dispose of baby diapers along with solid waste, although 122 (81.3%) of households knew that baby diapers were hazardous. According to a commentary by Sachdeva⁵, the sanitary waste produced in India was minimal compared with the sanitary waste generated in other countries, which was likewise in our study where most of the sanitary waste such as sanitary pads, used condoms, and menstruation-related clothes/towels were produced monthly or rarely.

This study has many strengths. First, there are very few community-based studies on domestic waste management in India. Second, it is an understanding that the production of biomedical waste occurs mostly in healthcare settings, and

we often defer from other areas such as domestic production. Third, this study highlights the unfocused areas of production of biomedical waste and the knowledge, attitude, and practice gap among the domestic pool consisting of urban and rural households in a coastal city of Karnataka. By this study, we recognize that we must focus on these areas of the community that will help us to detect, educate, and improve public health and prevent unnecessary consequences resulting from the hazards of the domestic biomedical waste output.

Our study also has certain limitations. The sample size was relatively small. The study participants were residing in the rural and urban field practice areas of the medical college, where medical students conducted health education sessions that may have influenced the segregation and waste disposal practices.

Conclusion

When quantification and assessment of the waste were accomplished, the most daily generated waste was baby diapers. In contrast, other sanitary wastes such as used condoms, menstruation-related particles, razor blades, and lancets were more commonly generated once a month. The segregation and disposal of such wastes were more among urban than rural households. The urban households had better knowledge and attitude toward hazardous healthcare waste segregation and disposal compared with rural households. The attitude was surprisingly affirmative to adopt proper segregation practices and facilities to correctly dispose of the biomedical waste produced at home. Regarding the practices, we observed that a significant number of houses adopted segregation practices, and urban households had used some form of protection when disposing of the waste. Performing this study helped us gain insights into the knowledge, attitude, and perception toward biomedical waste disposal among the selected rural and urban households in a coastal city of Karnataka.

Conflict of Interest

None declared.

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