

Onsite Proper Solid Waste Handling Practices and Associated Factors Among Condominium Residents in Debre-Markos Town, East Gojjam Zone, North West Ethiopia: A Community Based Cross-Sectional Study

Mulugeta Bantigegn¹, Achenef Motbainor² and Teferi Mekonnen³

^{1,2,3}School of Public Health College of Medicine and Health Science, Bahir- Dar University

¹mulusosi422@gmail.com, ²motbainor2@gmail.com, ³tmekonnen16@yahoo.com

Abstract— Background: Solid waste handling is defined as the separation, collection, storing, reducing, reusing or recycling and preparing for disposal of solid waste materials so as to reduce their effect on human health, environment and aesthetics. The government of Ethiopia constructed many condominium houses as a solution for the high need of residential houses to urban dwellers. However, waste handling and management practices have not given consideration and emphasis for the condominium houses.

Objective: The aim of this study was to assess the onsite proper solid waste handling practices and determine the associated factors among condominium residents in Debre Markos town, Amhara region, 2018.

Methods: A community based cross-sectional study was conducted in Debre-Markos town. A total of 343 households were selected by simple random sampling technique. Data were collected using interviewer administered structured questionnaire developed after reviewing different literature. The questionnaire was pre-tested on 5% of the total prior to the actual data collection time in other town. The reliability of questionnaire was assessed by Cronbach's alpha and found to be good ($\alpha=0.80$). Data were collected by nurses and environmental health professionals from March 22nd to 28th/2018. Completeness and consistency of data were checked on daily basis. Data were coded, entered and cleaned using Epi-info and exported to SPSS version 23 for further analysis. Bivariate and multivariate logistic regression analyses were employed to determine the significant association between independent and dependent variables. Binary logistic regression was run to identify candidate variables for multivariate logistic regression. Those variables with a p-value <0.25 in the binary logistic regression were entered in to multivariate analyses to control confounders and check the significant association between independent and dependent variables. Significant association was set at a p-value < 0.05 . The model fitness was checked by using Hosmer and Lemeshow goodness of fit test.

Results: All the 343 households, with 100% response rate, gave complete responses. The mean (\pm SD) age of participants was 31 (± 6.8) years. Proper solid waste handling practices of the participants in condominium was 23.9%. The main daily generated solid waste was food residue that accounts 37.3%. Almost ten percent (9.3%) of the households separated the waste at the source and 6.4% reused it. Residents who have low participation on solid waste campaign (AOR=2.11, 95% CI: 1.05-4.45), using single solid waste storage material (AOR= 5.34, 95% CI: 2.78-10.2), stored solid waste in plastic type of storage (AOR: 3.02, 95% CI= 1.61-5.64), residents' perceptions on lack of policy enforcement and responsibility (AOR: 2.16, 95% CI; 1.18-3.94) and households' with $<3,000$ Ethiopian birr monthly income (AOR=3.48, 95% CI: 1.65-7.60) were significantly associated factors with onsite proper handling practices.

Conclusions: Condominium residents' onsite solid waste handling practice found to be poor. Households' participation on solid waste management campaign, availability and communication of enforcement policies of solid waste handling practices to the residents need to be focusing area of proper solid waste handling practices.

Keywords— Solid waste, proper waste handling practice, waste storage, reuse, condominium residents.

I. INTRODUCTION

Solid waste is defined as non-liquid and/ or nongaseous products of human activities that are considered as unwanted (1). Waste is also described as unwanted or discarded material resulting from households, agricultural, commercial, communal and industrial activities (2). Onsite solid waste handling is defined as the separation, storing, collection, reusing or recycling, processing and preparing for final disposal of solid waste materials to reduce their effect on health, environment and aesthetics (3). Human beings continued to produce different types of waste materials that have negative health effects. However, communities in developing countries often turn to waste

handling methods that have proven to be destructive to human health and environment (5-7).

Africa is known to be the least developed region in the world with 38% urbanization which is low compared to many other countries in the world. African countries are experiencing rapid development with growth rate of four percent per annum (8). An inevitable consequence of population growth, urbanization and the consumption trend are rapidly increasing in the amount of solid waste production. Thus, African countries are now faced with huge amount of solid waste generation which has direct effect on the human health, safety and environment. At least hundred million people in East Africa lack access to improved sanitation due to poor handling practices and accumulation of solid wastes in the environment (5, 9).

As a result of rapid urbanization, Africa is currently suffering from an abundance of plastic bag waste pollution (5, 21, 22). As past research has identified, the stockholders such as national and local governments, municipal authorities contrasting increased urbanization and inadequate infrastructural facilities increases slums, ghettos, perceived as unhealthy (8, 23, 24, 25).

In the same manner, Ethiopia is facing rapid urbanization, leading to overcrowding and the expansion of slums and substandard settlements with poor waste handling practices. Urban residents generally lived in a very crowded settings than rural residents, which in turn causes to generate large quantities of solid wastes (10). Particularly, it is an urban issue, that closely related, directly or indirectly to a number of issues such as urban lifestyles, resource consumption patterns, jobs and income levels, and other socio-economic and cultural status of the residents (11).

In middle and lower-income countries such as Ethiopia, an estimated 30 to 50% of solid waste produced in urban areas is left uncollected. Some viral and other infectious diseases are associated with waste and also serve as habitat formation for breeding insects and mosquitoes (12). The major solid waste handling processes start at waste generation, waste separation, storage followed by each waste collection and preparing for final disposal. Basically, municipalities are giving preferences only on the collection and dumping of it, while the principle of 3R's (waste reduction, reusing and recycling) are not prioritized (13). Like other cities of developing countries, due to lack of waste handling information and implementation of the proclamation, most of the towns of Ethiopia are suffering from the adverse effects of improperly managed wastes (14).

In many cities of Ethiopia (Addis-Ababa, Adama, Kersa and Hosanna) waste handling is a growing public health concern since it is dumped along roadsides and into open areas, endangering health and attracting vermin (26, 27, 28).

In Amhara region the study conducted in Bahir Dar, Gondar and Debre-Birhan reported that the daily per capita solid waste generation rate for households was increased; while only few of households (8.5%) had practiced appropriate onsite handling (18). Constructing condominium houses as means of solving residential house problems in urban settings is good practice to solve the problem. However, there will be a potential waste management problem since people in the condominium lived in a very crowded manner. This will be worsening in low income countries that have not good experiences regarding to proper waste management system. Hence, studying onsite solid waste handling practices of the residents is very important to support the town municipality in order to avoid improper solid waste handling practice through set up creating for solid waste storages, providing trainings, implementing hygiene rules.

II. SIGNIFICANCE OF THE STUDY

The study would be a strong importance to give appropriate solutions for the existing problems. It will provide the evidence for the current solid waste handling practice. The study may support the town municipality in order to avoid improper solid waste handling practice through set up available solid waste storages, providing trainings, implementing hygiene rules.

The study may initiate the municipality and administration authorities to overcome the challenges by avoiding infrastructural problems such as streets in between buildings, waste storage site problems and financial constraints such as inability to buy appropriate solid waste storages and disseminate proper measures and practices aiming; on the elements or principles of proper solid waste handling practice (reduction, segregation at the source, reusing and storing commitment to participate in all schemes of the solid waste cycle on site household and off site level). This study will be important to understand the associated factors of the onsite proper solid waste handling practices of the condominium residents in general way. Similarly, the study will help the community to be involved in participating in community solid waste clean-up campaigns; thus, it can minimize public and environmental health burdens. Proper solid waste handling practices mentioned in this study are essential to be applicable for other condominium cities and towns.

These findings will help the policy makers to design a socially acceptable and environmentally friendly place with applying solid waste handling rules and regulations for the community of condominium in the country.

III. METHODS AND MATERIALS

Study setting

Debre-Markos is the town of East Gojjam zone located at 300 km from Addis Ababa, the capital city of Ethiopia to the North-West direction at 265 km far from Bahir Dar, the city of Amhara regional state to the South East direction. The town comprises seven kebeles (the smallest administrative units of the country) with a population estimated to be 107,129. The study was conducted in six condominium sites of the town. There are a total of 1,503 households in the six condominium sites namely Bole (450 HHs), Dibza (265 HHs), Hospital (104 HHs), Old Hospital (132 HHs), Geter Menged (256 HHs) and Aba-Yikunu (296 HHs). The town has one referral hospital, three health centers, more than seven private clinics and one family guidance association clinic (FGA) including town municipalities, sanitation & beautification department.

Source and study population

The source population includes all the six condominium HHs in Debre-Markos town. The study or sample population was the households found in the condominium houses included in the study. The study units were households that have been selected and included in the study. The study households who gave the information during data collection were household heads (particularly women above 18 years). All the households in the study population were eligible to be included in the study.

Sample size determination and sampling methods/ procedures

Sample size estimation process followed two approaches to address the two objectives. The sample size for the first objective was calculated by using a single population proportion formula, $n = z^2 \times p(1-p)/d^2$ considering the following assumptions; 24.8% solid waste handling practice from study done in the capital city of Guinea-Conakry (83), 95% confidence level, , and a five percent (5%) margin of error. Then, $n = z^2 \times p(1-p)/d^2 = 287 = [1.96 \times 1.96 \times 0.248 \times (0.752)] / (0.05)^2$, where n =sample size, z =1.96 (standard normal deviation corresponding to 95% confidence interval), p =0.248 solid waste handling practice from previous study, $q=1-p=0.752$ (complimentary probability of improper practice on solid waste handling) and $d=0.05$ (desired level of accuracy). But, for a small size population

($N < 10,000$) the minimum required sample size was calculated as $n_1 = n / (1 + n/N) = 287 / (1 + 287/6,463) = 275$, n_1 =the minimum adjusted required sample size, (N) is the study population (=6,463). Thus, the sample size was obtained from adjusted formula as, $n=275$. By adding non-response (10% contingency) rate=28, the final sample size became 303.

Alternatively, the sample size for the second objective was calculated using Epi info version 7.2 with an assumption of 95% confidence level, 80% of study power and five percent margin of error with consideration of gender, household income and educational status of respondents as a factor from previous study done in Guinea-Conakry (44). Then, the sample size of 312 was obtained from gender of respondents, since it gives maximum sample size by comparing with other factors and 10% maximum anticipated non-response rate addition, the final estimated sample size become 343 ($312 + 31 = 343$).

All condominium households were registered in Amhara building construction agency and each condominium households were listed in number starting from number one and ends with each different numbers; thus, by giving its identification codes from 1-1503 HHs, the 343 households were selected through simple random sampling methods from all the six condominium sites (from total of 1,503 HHs list).

Study Variables

Dependent variable: Onsite proper solid waste handling practice (proper practice/ non-proper practice)

Independent variables: Socio-demographic variables: (sex, age, family size, household income, housing condition, educational status and bed room type the house had)

Knowledge factors: (ideas on proper solid waste handling, technical knowledge, favorable methods of waste handling)

Lack of community participation: (participating in waste handling campaign)

The attitudinal factors: (thoughts, believes on proper solid waste handling).

Infrastructural factors: (streets in between building not comfort easily waste move to down through pedalic waste container, common places for waste).

Service and operational factors: (supervision, monitoring & evaluation, skills, training, perceptions of residents on lack of hygiene policy enforcement and responsibility)

Ineffective solid waste storage equipments: (in its types and quantity of solid waste storages; i.e. not being washable, movable or pedalic and water proof).

Operational definitions

Condominium: An apartment (buildings) constructed by government in such a way that the building shared walls and corridors that to private ownership.

Household solid wastes: Solid waste that are generated at residential home (41).

Household: A family or any group of people living together and sharing common goods including eating from same meal or dish whenever living, together.

Handling: The process of solid waste management from the source up to transfer site for final disposal operations.

Onsite: The place where the households practice the solid waste management at the source where solid waste is generated.

Practice: The habit of household's daily solid waste handling exercise from generation to until it will be collected and prepared for final disposal operations.

Appropriate storage: Solid waste storage which is not exposed to rain, sun, children and home animals like dogs, cows in respectable bins (water proof, moveable and washable storages).

Qurales: A name given to individuals that bought reusable and recyclable solid waste from the residents informally through door to door (13).

Reuse: The re-use of solid waste materials and other products without changing its shape (41).

Onsite proper solid waste handling practice: The action or experience of households regarding to solid waste separation at source, reusing, reduction, exchanging recyclable solid waste and storing appropriately. Thus, the total scores of "yes" responses for each items was considered as households who had on site proper solid waste handling practice (44).

Solid waste: Includes any garbage, refuse or other discarded materials including papers, newspapers, shoes, clothes, glass, plastics, solid cans.

Good knowledge: The study participants who answered more than mean score of the total knowledge questions was considered as to have good knowledge (44).

Good attitude: The study participants who answered more than mean score of the total attitude questions was considered as they had good attitude (44).

Data collection tools and techniques

Data were collected using interviewer administered structured questionnaire prepared by reviewing different literatures. The questionnaire has four sections such as socio-demographic, knowledge, attitude and practice questions of onsite proper solid waste handling practices. The questionnaire was first prepared in English and then translated to the local language Amharic and back to English to check and maintain its consistency. There was also observational check list prepared and used to collect data regarding to daily onsite solid waste handling practices supporting the interview. Five BSc holder health workers and one BSc nurse supervisor were selected and recruited for the data collection responsibilities.

Data quality and assurance

Different actions had been taken to maintain data quality. Pretest of the questionnaire was done on 5% total sample size in the nearby Kebele prior to the actual data collection period. Two days of training was given to data collectors and supervisor to bring them at the same level of understanding the questionnaire to administer the question in a similar way. The reliability of data collection tools for this study was assessed by Cronbach's alpha ($\alpha=0.80$). Moreover, the completeness and consistency of data were checked on daily basis by the supervisor and the principal investigator with necessary corrections to ensure all the information had been properly collected, completed and coded.

Data entry and analysis

Data were coded, entered and cleaned using Epi-info version 7.2 and exported to SPSS: version-23) for further analysis. Descriptive statistics was transformed and computed. Frequency, percentage, standard deviation, mean, and median were used for data description. Tables and graphs used to display descriptive data.

Bivariate analysis for each factor was conducted to determine the candidate for further or multivariate analysis. All variables with a p-value < 0.25 in the bivariate analysis were entered to the next step. Then multivariate analysis was conducted to assess the significant association between independent and dependent variables by controlling potential confounders. At this step, model fitness and the presence of multi-collinearity were assessed. The model fitness was checked by using Hosmer and Lemeshow goodness of fit that is observing the difference of $-2\log$ likelihood between the model with only the constant and with the predictors. Finally, 95% CI and adjusted odd ratio were

used to report the significant variables associated with dependent variable.

RESULTS

Socio-demographic characteristics

There were 343 households with 100% response rate, participated in this study and gave complete responses. Out of these participated households, 65.30% were women. The mean (\pm standard deviation) age of the respondents was 31 (\pm 6.80) years ranging from 18-73 years.

Regarding to religion, 90.70% of households were Orthodox Christian followed by Protestant (5.00%) and Muslim (4.40%). In their ethnicity, 93.20% of the households were Amhara. In addition, the respondent's educational status of the study participants found to be 28.60% first degree and 0.90% can't read and write. The average family size per households (1-4 and (5-7) persons per households was accounted as 86.30% and 13.70% respectively. In this finding, 70% of the households have been living in a rented house and majority of them 95.60% were used the house for housing purpose. About 54.20% of the households have been living in a single bed room house.

Concerning to income, the average monthly received income of households is grouped in quartile, the higher income was from 3,001-5,000 ETB (2nd quartile) and the minimum rank was households that received less than 3,000 ETB (1st quartile).

Table 1: Sociodemographic characteristics of the study households (n=343), Debre-Markos town, East-Gojjam Zone, Northwest-Ethiopia, 2018

Characteristics	Category	Frequency (N)	Percent (%)
Sex	Female	224	65.3
	Male	119	34.7
House ownership	Rent house	240	70
	Private house	103	30
The house that gives the service	For housing	328	95.6
	For commercial use	15	4.4
Bed room the house had	Studio	16	4.7
	One	186	54.2
	Two	132	38.5
	Three	9	2.6
Family size	1-4 members	296	86.3
	5-7 members	47	13.7
	<3,000 ETB	57	16.6

Average monthly income (in ETB)	3,001-5,000 ETB	159	46.4
	5,001-6,179 ETB	60	17.5
	>6,179 ETB	77	22.4
Higher Educational achievement	Not read & write	3	0.9
	Can read & write	26	7.6
	Primary	34	9.9
	Secondary	57	16.6
	Diploma	93	27.1
	First degree	98	28.6
	Masters & above	32	9.3

IV. PROPORTION OF PROPER SOLID WASTE HANDLING PRACTICE

The proportions of households onsite proper solid waste handling practice in the condominium was 23.90% with a 95% CI; (19.4-28.6).

This figure was computed from the respondents that exercising the five onsite proper solid waste handling practice indicators (separation of solid waste at source, reusing solid waste, exchanging solid waste for quales used for recycling, reduction of solid waste and storing solid waste appropriately).

The proportions of households solid waste separation practice was 9.30% with a 95% CI (6.4-12.5) and solid waste reusing was 6.40% with a 95% CI (4.1-9.0). Households who reduce solid waste at the source were 1.70% with a 95% CI (2.5-7.0) and those exchanging recyclable solid waste were five percent with a 95% CI (2.6-7.3).

The proportion of households who had practiced storing a solid waste temporarily in household level until it will be collected was also only 1.50% with a 95% CI (0.3-2.9).

Table 2: The proportions of onsite proper sold waste handling practices in condominium households (n=343), Debre-Markos town, East Gojjam zone, Northwest-Ethiopia, 2018

S	Characteristics	Category	Frequency (N)	Proportion of 95% CI
1	Separate solid waste	Yes	32	9.3 (6.4-12.5)

	No	311	90.7 (87.5-93.6)
	Yes	22	6.4 (4.1-9.0)
2	Reusing solid waste	No	321 93.6 (91.0-95.9)
	Yes	17	5.0 (2.6-7.3)
3	Exchanging solid waste	No	326 95.0 (92.7-97.4)
	Yes	06	1.7 (0.6-3.2)
4	Reduction of solid waste	No	337 98.3 (96.8-99.4)
	Yes	05	1.5 (0.3-2.9)
5	Storing SW appropriately	No	338 98.5 (97.1-99.7)
	Yes	17	5.0 (2.6-7.3)
6	Openly discarded/dumped SW	No	326 95.0 (92.7-97.4)
	Yes	82	23.9 (19.4-28.6)
7	Onsite proper solid waste handling practice	No	261 76.1 (71.4-80.6)
	Yes	272	50.1 (44.5-54.9)
8	Knowledge	No	271 49.9 (45.1-55.5)
	Yes	88	25.7 (21.9-30.3)
9	Attitude	No	255 74.3 (69.7-78.1)

Five percent of households had wholly discarded solid waste to nearby; whereas 78% of others haphazardly practice openly discarding everywhere in their villages. About 12.20% of the households practiced burning solid waste in the onsite residential areas.

Nearly all generated types of solid wastes in residents of households were biodegradable including food residues, vegetable peelings and fruit wastes, grasses, seed coats, kitchen and garden wastes, leaves, scarp of chat, papers, bones, cardboard, cartons and like. Whereas non-

biodegradable wastes of the condominium includes different types of plastics (like plastic bottles or highlands, plastic bags or “festals”, broken pieces of plastic materials, plastic packaging materials), textile scraps, cables and useless electronic materials, pieces of ceramics, pieces of metals, glass, cans, discarded old shoes and like wastes.

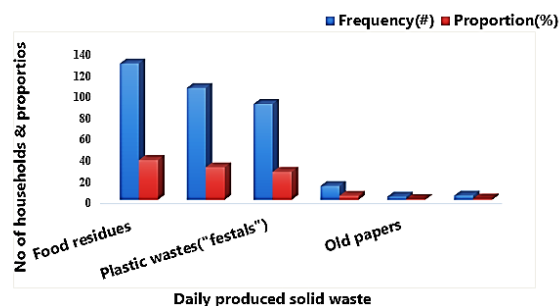


Figure 2: The most daily generated types of solid wastes, Debre-Markos, East-Gojjam zone, Northwest Ethiopia, 2018

V. SOLID WASTE SEPARATION

In this study, 9.30% of households solid waste was separated intended for “Qurales” and exchanged to other items by “Liwach”. As a result, 57% of the households separated different types of plastic solid waste items and nine 28.60% of them separated textiles and shoes items, 9.40% of households separated metal items, 6.30% bottles, glasses and cans items. Of these 46.90% of HHs separated solid waste for the purpose of reducing the volume of waste ever thrown to the environment; while 21.90% of them used for providing to other users and 18.80% of households separated for animal feeding such as food leftovers, leaves and grasses.

Reusing solid waste practice

Some of the households practiced reusing solid waste in the study population; it involves the use of a product more than once in its original form for the same or a new purpose; that can be used over and over instead of throw away. Twenty two (6.40%) of HHs practiced reusing solid waste. Textiles and shoes items were 36.40% widely reused solid waste items in this study. But, papers were only 4.50% HHs.

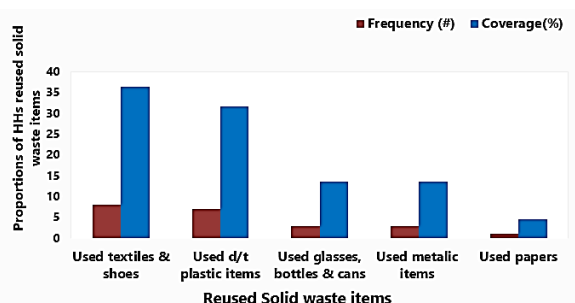


Figure-3: The frequency and proportions of reused solid waste items in condominium, Debre-Markos town, East-Gojjam zone, Northwest-Ethiopia, 2018

Solid waste storage

There were two types of storage activities at source of solid waste generation. The first one is temporary storage done at each household level the residents as a part of their hygiene; almost all 95% of households had solid waste storages. But, only 1.50% households stored solid waste appropriately and 78% discard solid waste unevenly. The second type is communal (garbage) solid waste storage for community solid waste containers prepared by municipality or town administration. Two hundred thirty seven (69.10%) interviewed households in the condominium had a single storage containers. However, 64.70% of households were not satisfied with the accesses of community solid waste garbages delivered by town municipalities.

Table 3: Types of solid waste storage materials that condominium households used (n=343), Debre-Markos town, East-Gojjam zone, Northwest-Ethiopia, 2018

Characteristics	Category	Frequency(N)	Percent (%)
Sack	Yes	326	95
	No	17	5.0
Basket	Yes	44	12.8
	No	299	87.2
Plastic container	Yes	104	30.3
	No	239	69.7
Waste bins	Yes	46	13.4
	No	297	86.6
Metal storage	Yes	6	1.75
	No	337	99.7

VI. FACTORS ASSOCIATED WITH ONSITE PROPER SOLID WASTE HANDLING PRACTICES

In this study, knowledge on solid waste handling practices and attitude factors are not significantly associated. But, household income, households who had a single solid waste storage equipment, low level of residents' participation on solid waste campaign, weak hygiene policy enforcement and responsibility, the absence of roads in between buildings are significantly associated with onsite proper solid waste handling practice. Accordingly;

The households' monthly incomes of the study households were significantly associated with onsite proper solid waste handling practice. The odds of HHs' who had monthly income of <3,000 ETB was 3.56 times (AOR: 3.48, 95% CI of (1.63-7.60) more likely at risk of practicing onsite proper solid waste handling than households who had monthly income >6,179 ETB.

Households who had stored solid waste in plastic type of storage equipment were significantly associated with onsite proper solid waste handling practice. The odds of onsite proper solid waste handling practice among HHs who used plastic type of storage was 3.02 times (AOR: 3.02, 95% CI= (1.61-5.64) more likely to at risk of practicing onsite proper solid waste handling than households who used waste bin type of storage equipment.

Households who had single (one) solid waste storage equipments were significantly associated with on-site proper solid waste handling practice. The odds of onsite proper solid waste handling practice among HHs who used single (one) solid waste storage was 5.34 times (AOR: 5.34, 95% CI= (2.78-10.2) more likely to at risk of practicing on-site proper solid waste handling than households who used three storage equipments.

Low level of condominium resident's participation on solid waste campaign: Low level of households' participation on solid waste campaign was significantly associated with onsite proper solid waste handling practice. The odds of onsite proper solid waste handling practice of the households who had lack of participation on solid waste campaign was 2.11 times (AOR: 2.60, 95% CI; 2.11(1.11-4.06) more likely at risk of practicing on-site proper solid waste handling practice than households who were participated in solid waste campaign.

Residents' perceptions on lack of policy enforcement and responsibility: Residents perception on lack of hygiene policy enforcement in their residential area and responsibility of town municipality of the study households was significantly associated with onsite proper solid waste handling practice. The odds of residents' perception on lack of hygiene policy enforcement in their residential area and responsibility of town municipality on the households were 2.16 times (AOR: 2.16, 95% CI; (1.18-3.94) more likely at risk of practicing onsite proper solid waste handling practice than households who had perceptions of hygiene policy enforcement and responsibility of town municipality.

The absence of streets between buildings of the households was significantly associated with onsite proper solid waste handling practice. The odds of lack of streets in between buildings of the households was twice (AOR: 2.00, 95% CI= (1.06-3.79) more likely at risk of practicing onsite proper solid waste handling than households who had the access of streets in between buildings.

Table 4: Bivariable and multivariable analysis of associated factors and onsite proper solid waste handling

practice, Debre-Markos town, East-Gojjam zone, Northwest-Ethiopia, 2018

VII. DISCUSSION

Variables	Onsite proper solid waste handling practice				
	Category	Yes	No	COR (95%CI) AOR (95%CI)	
Sex	Male	26(21.8%)	56(25%)	0.84(0.4-1.42)	0.73(0.2-1.18)
	Female	93(78.2%)	168(75%)	1	1
Monthly income (ETB)	<3,000	38(38%)	39(16%)	3.78(1.9-6.89)***	3.48(1.6-7.60)**
	3,000-5,000	22(22%)	71(29.2%)	1.19(0.4-5-1.95)*	0.86(0.3-4-3.02)
	5,001-6,179	23(23%)	67(27.6%)	1.32(0.6-3-2.49)*	1.18(0.3-9-3.38)
	>6,179	17(17%)	66(27.2%)	1	1
House ownership	Rented	80(77.7%)	181(75.4%)	1.13(0.6-5-1.96)	1.06(0.5-0-2.25)
	Private	23(22.3%)	59(24.6%)	1	1
	Primary	05(1%)	27(18.9%)	1	1
Educational status	2ndary	20(23.8%)	73(28.2%)	1.48(0.28-2.85)	1.17(0.5-8-14.75)
	Diploma	26(31%)	72(27.8%)	1.95(0.4-2-3.29)	1.70(0.2-6-6.19)
	1stdegree	10(11.9%)	24(9.3%)	2.25(0.7-6-5.38)	2.11(0.5-6-12.19)
	2nddegree & above	19(22.6%)	41(15.8%)	0.25(0.1-5-2.00)	2.22(0.6-8-14.36)
Knowledge	Good	39(47.6%)	132(50.6%)	1.13(0.6-9-1.85)	1.41(0.6-4-3.12)
	Poor	43(52.4%)	129(49.4%)	1	1
Attitude	Good	18(22%)	70(26.8%)	0.76(0.4-2-1.36)	1.03(0.5-3-1.99)
	Poor	64(78%)	191(73.2%)	1	1
Types of solid waste storage	Plastic	205 (50%)	32 (21%)	5.72(3.3-9.75)***	3.02(1.6-5.64)**
	Waste bin	56(54.5%)	50(20%)	1	1
Number of solid waste storages	One	204(86.1%)	49(45.8%)	7.28(4.2-12.4)***	5.34(2.7-8-10.2)***
	Three	33(13.9%)	58(54.2%)	1	1
Low level of participation on solid waste campaign	Yes	43(41%)	40(16.8%)	3.35(1.9-7-5.54)***	2.11(1.1-1-4.06)*
	No	62(59%)	198(83.2%)	1	1
Perceptions on lack of hygiene policy enforcement & responsibility	Yes	45(36.6%)	37(16.8%)	2.85(1.4-6-4.01)**	2.16(1.1-8-3.94)*
	No	78(63.4%)	183(83.2%)	1	1
Lack of access of streets in between buildings	Yes	47(57.3%)	88 (33.7%)	2.64(1.4-7-4.09)**	2.00(1.0-6-3.79)*
	No	35(42.7%)	173 (66.3%)	1	1

(*) P<0.05 (significant label), (**) P<0.01(significant label) and (***) P<0.001(significant label)

In this study, the proportions of onsite proper solid waste handling practices and the associated factors were reported. The major solid waste handling processes or functional elements started at waste generation, followed by solid waste handling and sorting, principal waste handling (reduction, reusing and exchanging), storing, collection and preparing for disposal (13) are described. Females were most participated in household solid waste handling practices in this survey; which is the same to the study done in Debre-Berhan and Australia (25,44).

The most daily generated solid waste in the study was food residues which is similar to the study findings in Laga Tafo Laga Dadi. The households in this study practiced open dumping and burning which is also similar to the study done in Dessie, Kersa district of Eastern Ethiopia, Adama city, Awka and Owerri Imo state-Nigeria (10, 26, 27, 44, 45). In this study, most households did not practice solid waste separation; that is contrasted to the study in South Africa and Awka-Nigeria (45). The difference could be associated with the fact that South Africa is a bite advanced country and may have different alternatives; it could be market or service availability for those separated wastes compared to Ethiopia especially Debre Markos town. There might also be policies and enforcement rules in the specified countries for those who did not practice properly waste handling and management issues. This is a serious solid waste handling step for the households of community, because separation minimizes solid waste that could be disposed to environment, it could be reused, recycled (could be exchanged) rather made bad settings (12).

Different types of plastic solid waste followed by textiles and old shoes are separated and stored solid waste in this scenario; this is unlike to the study had done in Dessie town (10). This may be due to the result of poor practices of reusing and exchanging solid waste materials from house to house. The majority of interviews in condominium had a single and sack type of solid waste containers which was widely used type of storage in the area; this may be due to easily available and less costly than other types; that is similar to the study conducted in households of Debre-Berhan in Ethiopia (25). In this study, the households' solid waste separation and reduction was few; whereas, the reusing , exchanging of solid waste to Qurales or Liwach for recycling as raw materials and storing solid waste in appropriate storages temporarily were also very limited that is similar to study in Debre-Birhan(25). Therefore, the overall proportion of condominium household's proper solid waste handling practice was as poor as

(23.90%). That is slightly similar to the study conducted in Guinea-Conakry which is labeled as poor (42, 44) and different from Debre-Berhan town HH solid waste practice (25). This may be due to difference in socio-economic status of the households of each country Ethiopia and Guinea; but also condominium households may differ from town households due to socio-economic status in case of Debre-Birhan. Reusing solid waste in condominium residents was not widely practiced; this result is compatible to the previous study conducted at Dessie town (10). Although, respondents of the households had good knowellage and low level of attitude about solid waste handling practice; unlike to Dessie town (10); but no one had taken cares about its benefits and effects on health and environment as consequences.

The results of this study indicate that the households had important roles and responsibilities on the improper solid waste handling practice of condominium. Then, the possible predictors were, ineffective solid waste storage equipment's, household monthly income, low level of households' perceptions on policy enforcement, infrastructural constraints and lack of community participation on solid waste campaign. Similar findings have been described in previous many literatures conducted in developing countries and others (4, 5-7,10, 12, 30, 32-36, 37-39). In the multivariable analysis, the strongest predictor for on-site proper solid waste handling practice were ineffective storage equipment (households who had single solid waste storage and households having average monthly income less than 3,000 ETB) on on-site proper solid waste handling practice; (the aim given to proper practice, payment to the service charge, engaging environmentally friendly waste materials was highly limited with related to income). This is similarly stated in a case study in Nablus district-Palestine, in Africa and Israel (32, 33).

In this finding; infrastructural constraints (the absence of streets in between buildings) can influence the on-site proper solid waste handling practice with a significant implication in the study area. As a result, majority of households had a thought on solid waste handling practice among residents who resided above ground floor (G+1, G+2 and G+3) discarded solid waste compared to ground floor. After the solid waste was stored, it might be easily come down to the ground, instead the residents had chance to minimize the load and then throw out through windows.

Most sites of the condominium have no streets in between buildings in order to put solid waste at community garbage especially in rainy season; condominium buildings have no walkways to take solid

waste to community garbage. Sometimes there was no known communal garbage (storages) around and even if it is not fenced; this results with irresponsible body to the discarded waste in the compound which is the same issues in developing countries (5, 32). The extent to which households can't participate effectively on solid waste handling practice (e.g. in solid waste campaign) was also another challenge tackles onsite proper solid waste handling practice. The better involvement of the community in environmental activities increases the practice of solid waste handling that well-matched to the former research in Gondar, Ghana, Uganda and China (12, 30) respectively.

Another important finding is residents' perceptions on lack of hygiene policy enforcement in their residential area and responsibility of town municipality and administration on onsite proper solid waste handling practice; even though, the rules and regulations had existed. This study is the same to the study conducted in Guatemala, waste handling service was limited because of it constitute low priority for policy makers and planners (3, 36, 37, 38). Proper waste handling is still lacking in most towns of the country. There is regulation and policies dedicate how the solid waste to be handled, but it is not implemented properly (4, 39).

VIII. CONCLUSIONS & RECOMMENDATIONS

Most of the households involved in solid waste handling practice were women. Study participants in this study are not practiced proper solid waste separation, reducing solid waste at source, reusing and exchanging recyclable solid waste materials and storing it in appropriate materials at household level and at community garbages. A single and local onsite solid waste storage container is widely used instead of two or more storages. This study revealed that households of Debre-Markos condominium solid waste handling practices are found to be poor.

In general proper solid waste handling practice is tackled through households' income, infrastructural constraints, placement of communal garbage, ineffective solid waste storages, low level of households' participation on solid waste programs and low level of households' perceptions on hygiene policy enforcement and irresponsibility of authorities. Therefore, town administration and municipality have to establish the appropriate solid waste storage containers (in its type and number). Similarly, communal waste bins and garbage should be movable, color coded to put separated waste and have its cover or shades) in each sites of the condominium. The town administration have to prepare specified rules and regulations that focused on how to

handle solid waste, allocate the accountable body and firmly enforce this rules and regulations under close supervision and inter organizational linkage and by designing the sensitization and training schedules

ACKNOWLEDGEMENTS

We would like to express our gratitude to all Debre-Markos town Municipalities, housing development & condominium construction office assists on the necessary baseline information, we gratefully thanks Bahir-Dar university, for its generous assistance throughout the study. We also special acknowledges go to the respondents who participated in this study.

REFERENCES

- [1] Leton T O. (2004). Definition, operations in the Niger delta region of Nigeria, (Eng. Geol 73): pages 171-177.
- [2] IW, and Designing an Economic Instrument for Sustainable Solid Waste Management in the Household Sector, 2014.
- [3] Seng B, Kaneko, H., Hirayama, K., Katayama-Hirayama, K. Municipal solid waste management in Phnom Penh, capital city of Cambodia. Waste Management & Research. 2010:491-500.
- [4] Mgimba C SA. (2016). Municipal Solid Waste Composition Characterization for Sustainable Management Systems in Mbeya City, Tanzania. International Journal of Science, Environment and Technology; vol-5:pages (47-58).
- [5] Jessica McAllister USU. (2015). Factors influencing solid-waste Management in the developing world.
- [6] Al-Khatib; (2015). Public perception of hazardousness caused by current trends of municipal solid waste management; vol-36: pages (323-330).
- [7] Kabbashi NA. (2016). A review of Solid Waste Management in Africa.
- [8] Muzenda E BM, Mollagee M, Motampane N, Ntuli F. (2011). Efecting on Waste Management Strategies for South Africa; vol-2 (World Congr Eng Comput Sci): pages(19-21).
- [9] (IPA. (2014). Prevalence of Work-Related Rhino-Conjunctivitis and Respiratory Symptoms Among Domestic Waste Collectors.
- [10] Cheru S; (2011). Case Study of Household Solid Waste Management.
- [11] Gedefaw M. (2015). Assessing the Current Status of Solid Waste Management of Gondar Town, Ethiopia.
- [12] Cheru S. (2010). Case Study of Household Solid Waste Management in Arada-Sub-City, Addis Ababa, Ethiopia.
- [13] Zebenay K. (2010). The challenges of solid waste management in urban areas, the case of Debre markos town Addis Ababa University, Ethiopia.
- [14] Federal Negarit Gazeta PN. (2007 E.C). Solid waste management proclamation 2007 E.C. Negarit Gazeta, 12th February, 2007 E.C.
- [15] Abebe S. (2014). Assessment of the Liquid Waste Management Practice of Condominium Houses in Addis Ababa, Ethiopia.
- [16] Mesfin Assefa MM. (2017). Solid Waste Generation Rate and Characterization Study for Laga Tafo Laga Dadi Town, Oromia, Ethiopia. International Journal of Environmental Protection and Policy; Vol.5, No.6 (doi:10.11648/j.ijepp; 20170506.11): pages (84-93).
- [17] Abdirizaq Eddle Ibrahim IY, Dr. Piyush Pandey, Dr. Ravindra Gaikwad. (2016). Analysis of integrated solid waste management systems and inadequate landfill disposal; vol-1 (issue-2).
- [18] Al RKAae. (2012). Sustainable Solid Waste Management in India.
- [19] (NBSC) NBoSoC, editor. (2015). China Statistical Yearbook. Beijing, China: China Statistics Press;.
- [20] Abdirizaq Eddle Ibrahim. (2017). Effects of solid waste management in kitengela ward a case study of kajiado country.
- [21] Abdirizaq Eddle Ibrahim IY, Dr. Piyush Pandey, Dr. Ravindra Gaikwad. (2016). Analysis of integrated solid waste management systems and inadequate landfill disposal; vol-1(issue-2).
- [22] Yire; (2012). Analysis of integrated solid waste management systems and inadequate landfill disposal, [www.metrovancouver.org/...waste/Solid Waste Publications/Solid Waste Management].
- [23] Tai J, Zhang, W. Che, Y., Feng, D. (2011). Municipal solid waste source-separated collection in China: a comparative analysis. Journal of Waste Management; vol-31:pp.(1673-1682).
- [24] Suraiya Yasmin MIR. (2016). A review of Solid Waste Management Practice in Dhaka City, Bangladesh.
- [25] Asmamaw Abera Kebede hwwboetudb. Household Solid Waste Generation Rate and Onsite Handling Practices in Debre Berhan Town, Ethiopia, (2016).
- [26] Woldetsadik AA. (2016). Practices of Solid Waste Management by Municipality and Community in Oromia Regional State of Ethiopia: A Case of Adama City, Ethiopia.

- [27] Endalu Lemma HT. (2014). Characterization and Disposal of Municipal Solid Waste, Case Study, Hosanna Town.
- [28] Environment EFF, editor. (2010). Solid Waste Characterization & Quantification of Bahir Dar City; Addis Ababa, Ethiopia.
- [29] Zhujie Chu WW, Bairong Wang, and Jun Zhuang .(2016). Research on Factors Influencing Municipal Household Solid Waste Separate Collection: Bayesian Belief Networks, *www.mdpi.com, journal, sustainability*; vol-8, p152.
- [30] Moore, editor. (2012). Country solid waste management plan. USA: Golder Associates.
- [31] O'Connell EJ. (2011). Increasing Public Participation in Municipal Solid Waste Reduction, Sustainability Education Prescott College Aspen, Colorado.
- [32] A-Keahddjj. (2010.) Solid waste characterization, quantification and management practices in developing countries. A case study: Nablus district-Palestine; pages (1131–1138).
- [33] Nissim I, ShoIsraelhat, T., Inbar, Y. (2015). From dumping to sanitary land fills - Solid waste management in Israel. *Journal of Waste Management*; vol-25: pp.(323-327).
- [34] Marshall hddos. (2013). Household Solid Waste Generation in Urban Pakistan: A Case Study of Rawalpindi.
- [35] Zurbrügg C, Drescher, S., Rytz I., Sinha M., Enayetullah I. (2015). Decentralized composting in Bangladesh, a win-win situation for all stakeholders. *Resources, Conservation and Recycling*; vol-43: pages (281-292).
- [36] Mahmood Zohoori AG. (2017). *International Journal of Science and Engineering Applications. Municipal Solid Waste Management Challenges and Problems for Cities in Low-Income and Developing Countries*; Vol-6 (Issue 02): ISSN-2319-7560 (Online)
- [37] Asefa Abahumna Woldetsadik E. (2017). Practices of Solid Waste Management by Municipality and Community in Oromia Regional State of Ethiopia: a Case of Adama City.
- [38] Suraiya Yasmin. MIR. a review of Solid Waste Management Practice in Dhaka City, Bangladesh, 2016.
- [39] Census (2007 E.C); Population and housing census of Ethiopia.
- [40] Construction MoUDa, editor. (2012). Solid Waste Management Manual: With Respect to Addis Ababa, Ethiopia: Urban Plans, Sanitary Landfill Sites and Solid Waste Management Planning April.
- [41] Oxford dictionary 10th edition hiroaaavyip-h. (2010). *Management*; vol-12, issues-27): pages (228-241).
- [42] <https://www.google.com/search> or www.mcswa.wordpress.com. (2014) proper solid waste management.
- [43] Mamady AfK. (2015). A Cross-Sectional Study: Factors Influencing Attitude, Safety Behavior, and Knowledge regarding Household Waste Handling in Guinea.
- [44] Assessment of Waste Management Practices among Residents of Owerri Municipal Imo State Nigeria, *Journal of Environmental Protection*; (2015), vol-6, pp (446-456).
- [45] Hewitt B, Baxter, J., Givans, S., Murphy, M., Myers, P. and Meiklejohn, C. (November-2010). Final Report on “Men’s Engagement in Shared Care and Domestic Work in Australia”. University of Queensland Office for Women, Department of Families, Housing, Community Services and Indigenous Affairs. The Social Research Centre and the Institute for Social Science Research: pp-78.