Assessment of status of solid waste management in Asella town, Ethiopia

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Abstract

Background: Improper solid waste management (SWM) is a major public health and environmental concern in the urban areas of many developing countries such as Asella Town. The aim of this study was to assess the status of SWM in Asella town.

Methods: A community-based cross-sectional study design was used to assess the status of improper SWM and associated factors in Asella town. From the total of eight kebeles (smallest administrative unit in Ethiopia) four kebeles were randomly selected using lottery method. The sample size was 413 households. The households were proportionally allocated to each randomly selected kebeles. The data was collected by pretested questionnaire in the local language. Data was entered using statistical software Epi Info version seven and transferred to SPSS version 21. Descriptive data analysis was done to summarize the socioeconomic status of the respondents. Chi-square was used to show the association between the status of solid waste management and different variables. Binary logistic regression was used to determine the potential factors for improper SWM.

Result: 332 (82.8%), had improper solid waste management practice. Lack of adequate knowledge about solid waste management and not having access to door to door solid waste collection could have contributed to the reported improper solid waste practice. Participants who didn’t have access to door to door solid waste collection service were about three times more likely to practice improper solid waste management when compared to those who had access (AOR = 2.873, 95 CI (1.565, 5.273) \( P = 0.001 \)).

Conclusion: The study finding showed that, the majority of the residents practiced improper solid waste management. Lack of adequate knowledge about solid waste management and not having access to door to door solid waste collection could have contributed to the reported improper solid waste practice. Therefore, there is a need to enhance the awareness of the community about proper SWM and to improve the door to door solid waste collection service by the town municipality.

Keywords: Solid waste management, Asella, Ethiopia
especially in the capital city. In Addis Ababa the awareness of the community members about solid waste management is enhanced and more than 70% of the community inhabitant were willing to pay for door to door solid waste collection service which is one of the initiatives introduced by the government [5].

Asella is an old town with many public and private hospitals, health centers, industries, hotels and small scale enterprise where lots of solid waste is generated. The town municipality is mainly responsible for solid waste management of the town as there is no private organization involved in such tasks. There is no communal solid waste container deployed in different sites of the town, as a result solid waste produced from every household are collected on road side. Even though, solid waste management is supposed to be one of the critical public problems in Asella, there was no study done to systematically assess the magnitude of the problem and the factors for the improper waste management. The aim of this cross sectional study was to assess the status of household based improper solid waste management and to identify factors for improper solid waste management in Asella town. Findings of the study could help local policy makers to develop solid waste management related problems solving policies. It could also serve as baseline study to conduct similar study at a regional level.

Methods

Study area, design and subjects
The study area, Asella Town, is a capital city of Arsi zone established in 1945. It is located 175 Kmsoutheast of Addis Ababa. The total area of Asella town is about 4623 ha. Topography is characterized as rugged and inclined. The city is mainly characterized as highland’s climate condition. According to the census conducted by Central Statistical Agency (CSA) in 2007, the total population of Asella city was 65,250 with a growth rate of 2.99%. The major economic activities in the city are trade, urban agriculture, investment such as hotel, construction, factories, flour and food complex, food oil production, micro and small-scale enterprises and other informal business activities like street trades [6]. In Asella town, open dumping is the common method of waste disposal practice. Almost all generated solid waste in this town is indiscriminately dumped into streams, open surfaces, ditches, and residential compounds and along the highway crossing the town.

A community-based cross-sectional quantitative study design was used to assess the status of solid waste management and associated risk factors in Asella town from March 1/2017 to June 20/2017.

The sample size was calculated using computer generating (Epi Info) statCalc [7] considering the total estimated household number of the town, 15,966 at 95% level of confidence. Adding the 10% contingency the final sample size was 413.

From the total of 8 kebeles (smallest administrative unit in Ethiopia) 44 kebeles were randomly selected using lottery method. The calculated household number was proportionally allocated to each randomly selected kebele.

Operational definitions
Improper solid waste management; in this study improper solid waste management practice is defined as not separating solid waste appropriately and/or disposing solid waste at a legally unauthorized place.

Data collection procedures
The data including sex, age, educational status, marital status, family size and practice of solid waste management were collected through an interviewer and self-administered pretested and updated questionnaires with both open and close ended questions (Additional file 1). The questionnaire was adopted from different guidelines and customized according to the study area setup. It was initially prepared in English and translated to the local language, Afan Oromo. The questionnaire was tested and edited before the actual data collection. Field observation was

| Variable                          | Frequency | Percent |
|----------------------------------|-----------|---------|
| Age Group                        |           |         |
| 15–25                            | 39        | 9.7     |
| 26–35                            | 166       | 41.4    |
| 36–45                            | 109       | 27.2    |
| Above 45                         | 87        | 21.7    |
| Gender                           |           |         |
| Female                           | 285       | 71       |
| Male                             | 116       | 29       |
| Educational status               |           |         |
| Unable to read and write         | 34        | 8.5     |
| Able to read and write           | 99        | 24.7    |
| Grade 9–12 complete              | 177       | 44.1    |
| Diploma                          | 43        | 10.9    |
| First degree and above           | 48        | 12      |
| Occupational status              |           |         |
| Government employee              | 133       | 33.2    |
| Merchant                         | 71        | 17.7    |
| Daily labour                     | 47        | 11.7    |
| Urban agriculture                | 15        | 3.7     |
| Housewife                        | 111       | 27.6    |
| Others                           | 24        | 6       |
employed for understanding households’ solid waste management condition, dumping in open space, river ditch and road, solid waste collection and transportation systems and disposal site facilities of the town. Photographs were taken during field observation for dumping sites and illegal solid waste management practice by the community. Data collection and analysis were done according to STROBE (Strengthening The Reporting of Observational Studies in Epidemiology) checklist.

**Data processing and analysis**
The data was entered using statistical software Epi Info version seven and transferred to SPSS version 21. Descriptive data analysis was done to summarize the socioeconomic status of the respondents. Chi-square was used to show the association between the status of solid waste management and different variables. Binary logistic regression was used to determine the best predictors of improper solid waste management.

**Limitation of the study**
The term improper solid waste management is broad. Separation of waste is also relative as there is no standard regulation of solid waste separation practiced in the community.

**Ethical considerations**
The study was ethically approved by the ethical review committee of Arsi University, College of Health Sciences. Formal letters were written to all concerned authorities and permission was secured at all levels. As the study didn’t include any invasive procedures, only informed verbal consent was collected from each respondent after explaining the purpose and procedure of the study. Written consent was exempted by the research review committee of the college. The anonymity of participants was maintained.

**Results**
From the randomly selected households, 401 were included in to the assessment. This makes the response rate

![Fig. 1 Frequency distribution of types of solid waste generated and disposed of by households from multiple responses in Arsi Zone Oromia Regional State Asella town, 2017](image-url)
97%. 285 (71%) of the respondents were female. The mean age of the respondents was 38 (+SD of 11.97) and 166 (44.1%) were in the age range of 26–35 years. Regarding their marital status, 276(68.8%) and 59(14%) of them were married and single, respectively. Orthodox Christian was the predominant religion 257(63.9%) among the study participants. 306 (76.3%) of the participants earn monthly income less than 80 USD. (Table 1).

Composition of municipal solid waste in Asella
Variety of solid waste was reported to be generated from the households included in to the study. Accordingly; 328, 296 and 285 households’ heads have reported that they generated plastic, food residual and paper wastes, respectively (Fig. 1).

One hundred nine (27.2%) of households separated their solid waste at source. Solid waste was collected by the municipality in more than 1 month from 192(47.9%) households and 81(20.2%) of the households had no solid waste collection service. Majority, 359(89.5%) of the households did not practice reduce and reuse strategy and 307(76.6%) households burned solid waste in their compound (Table 2).

Table 2 Frequency distribution of households solid waste management practices in Arsi Zone Oromia Regional State Asella town, 2017

| Variables                              | Frequency | Percentage |
|----------------------------------------|-----------|------------|
| Separation solid waste at your home    |           |            |
| Yes                                    | 109       | 27.2       |
| No                                     | 292       | 72.8       |
| Collection interval of SW              |           |            |
| Once a two week                         | 55        | 13.7       |
| Once a month                           | 51        | 12.7       |
| More than a month                      | 192       | 47.9       |
| No serve at all                        | 81        | 20.2       |
| Practicing Reduce, Reuse and Recycle strategy |       |            |
| Yes                                    | 42        | 10.5       |
| No                                     | 359       | 89.5       |
| Disposing SW on the road               |           |            |
| No                                     | 304       | 75.8       |
| Yes                                    | 97        | 24.2       |
| Do you dispose of SW in the ditch      |           |            |
| No                                     | 367       | 91.5       |
| Yes                                    | 34        | 8.5        |
| Do you dump SW in the yard             |           |            |
| No                                     | 372       | 92.8       |
| Yes                                    | 29        | 7.2        |
| Burn SW in the compound                |           |            |
| No                                     | 94        | 23.4       |
| Yes                                    | 307       | 76.6       |

332 (82.8%) participants had improper solid waste management practice (Figs. 2 and 3). Not having access to door to door solid waste collection service from municipality, not having knowledge about solid waste management and 3R (P = 0.001), and being unwilling to pay for solid waste management (P = 0.024) had statically significant association with improper solid waste management practice (Table 3). Other factors such as education status and occupation had no statistically significant association (P > 0.05) with improper solid waste management practice.

Factors contributing to improper solid waste Management in Asella town
All the independent variables with P-Value less than 0.05 by bivariate analysis were entered into a multivariate logistic regression analysis, to analyse the contributing factors for improper solid waste management. Those households who had no door to door solid waste collection service were about three times more likely to practice improper solid waste management (Adjusted Odds Ratio(AOR) = 2.883, 95% Confidence interval(CI) (1.5705, 5.295) P = 0.001) than those who had the service (Table 4).
Discussion

The majority, 72.8%, of respondents didn’t separate solid waste at source. The type of wastes generated includes; Plastic (34.8%), Food residual (31.4%), Paper (30.3), Metal wastes (1%) and other wastes (2.5%). The high level of improper Solid waste management practice were consistent with study findings from Nigeria 83.3% [8], Ghana 82.7% [9] and Gonder, Ethiopia 69.7% [10]. The current solid waste management practice was much lower than the practice seen in Kampala [11]. Even though the economic status of the town is relatively similar with the study area, due to the fact that the people in Kampala use their solid waste to produce manure, their solid waste management practice was much higher than households in Asella town.

In developing countries improper solid waste disposal is common and about half of the respondents in our study dispose their solid waste improperly (dumping in the yard, burn in their compound, throwing in the ditch and in the river). A study done in Keko Machungwa, Tanzania revealed that 62% of residences dispose wastes in unauthorized place, this high improper solid waste disposal was because of inaccessibility due to informal settlements and narrow roads [12]. Similarly, a high improper solid waste disposal practice 75% was reported from Debrebrihan, Ethiopia [13].

| Variables                              | Solid waste management practice | p value |
|----------------------------------------|---------------------------------|---------|
|                                       | Proper | Improper |         |
| Gender                                 | Female | 46 16.2  | 238 83.8 | 0.467  |
|                                       | Male   | 23 19.7  | 94 80.3  |         |
| Family size                            |        |          |          |         |
| 1–3                                    | 21 12.7 | 145 87.3 | 0.05    |
| 4–6                                    | 45 21.6 | 163 21.6 |         |
| 7–9                                    | 3 11.1  | 24 88.9  |         |
| Access to door to door waste collection|        |          |          |         |
| Yes                                    | 49 28.7 | 122 77.3 | < 0.001*|
| No                                     | 20 8.7  | 210 91.3 |         |
| Knowledge of rule and regulation of SWM|        |          |          |         |
| Yes                                    | 16 37.2 | 27 62.8  | 0.001*  |
| No                                     | 53 14.8 | 305 85.2 |         |
| Knowledge of about 3R                  |        |          |          |         |
| Yes                                    | 24 30.8 | 54 69.2  | 0.001*  |
| No                                     | 45 13.1 | 278 86.1 |         |
| Willing to pay for SWM                 |        |          |          |         |
| Yes                                    | 65 19   | 278 81   | 0.024*  |
| No                                     | 4 6.9   | 54 93.1  |         |
| Consider waste as a resource           |        |          |          |         |
| Yes                                    | 44 25   | 132 75   | < 0.001*|
| No                                     | 25 11.1 | 200 88.9 |         |
| Practicing 3R                          |        |          |          |         |
| Yes                                    | 17 40.5 | 25 59.5  | < 0.001*|
| No                                     | 52 14.5 | 307 85.5 |         |
This high improper solid waste disposal practice in our study area could be because of the long door to door solid waste collection interval, in which only 26% of the households had the service monthly. Lack of door to door solid waste collection service by town municipality was found to be the potential risk factor for improper solid waste management practice in Asella town, as those households with door to door solid waste collection service were about three times more likely to have proper solid waste management practice.

There was relatively low access to the door to door solid waste collection service and the long interval of collection compared to the study done in the capital city, Addis Ababa. In which 84% of the households had access to door to door solid waste collection [14]. This difference in the accessibility of door to door collection service could be due the poor infrastructure in Asella town and difference in regulations of solid waste management. In the capital city there is better infrastructure of transport in which most households are accessible and the service is accessible for those who are willing to pay [5, 14]. But in Asella town, households are not easily accessible due to the lack convenient roads and the door to door solid waste collection is handled mainly by the town municipality in which there is no direct payment for each solid waste collection service. Similar studies done in Mombasa, Kenya [15] and Adama, Ethiopia [16] showed that there were better door to door solid waste collection service.

Besides to the poor door to door solid waste collection service, the awareness of the households about rules and regulation of solid waste management (10.7%) and practice of 3R (10.4%) were poor. The awareness of solid waste management in the study area was lower than the study findings from Gonder [10] and Bahirdar, Ethiopia [17]. This difference in awareness could be due to the involvement of Nongovernmental organizations such as the Dream Light private limited company in Bahridar which is mainly engaged in proper solid waste management awareness creation among the community members of the city [17].

**Table 4** Bivariate and multivariate analysis for factors association with improper solid waste management in Arsi Zone Oromia Regional State Asella town, 2017

| Variables                              | Improper SWM | OR (95% CI) | AOR (95% CI) |
|----------------------------------------|--------------|-------------|--------------|
|                                        | Yes          | No          | COR          | AOR          | 95% CI | * Statistically significant associationn |
| No access to door to door solid waste collection | Yes          | 210 20      | 4.217        | 2.883        | 1.570  | 5.295* | 0.001* |
|                                        | No           | 122 49      | 1            | 1            |        |        |        |
| Inadequate knowledge of rule and regulation of SWM | Yes          | 305 53      | 3.41         | 2.029        | 0.966  | 4.260  | 0.062  |
|                                        | No           | 27 16       | 1            | 1            |        |        |        |
| Not considering waste as a resource    | Yes          | 200 25      | 2.667        | 1.506        | 0.767  | 2.576  | 0.271  |
|                                        | No           | 132 44      | 1            | 1            |        |        |        |
| Inadequate knowledge of about 3R       | Yes          | 278 45      | 2.746        | 1.623        | 0.693  | 2.735  | 0.361  |
|                                        | No           | 54 24       | 1            | 1            |        |        |        |
| Unwilling to pay for SWM               | Yes          | 54 4        | 3.156        | 2.059        | 0.659  | 5.884  | 0.225  |
|                                        | No           | 278 65      | 1            | 1            |        |        |        |

* Statistically significant associationn

**Conclusion and recommendations**

This study showed that, more than 82% of Asella town residents practice improper solid waste management. Lack of adequate knowledge about solid waste management and not having access to door to door solid waste collection could have contributed to the reported improper solid waste practice. Therefore, there is a need for enhancing the awareness of solid waste management at the community level. We also recommend the municipality of Asella to enhance the accessibility of door to door solid waste collection service. Further studies to assess the status of SWM in different town within the district could help to have comprehensive image about SWM in the district and to convince policy makers to give emphasis to the issue.

**Additional files**

**Additional file 1:** Questionnaire prepared for households. (DOCX 17 kb)

**Abbreviations**

AOR: Adjusted Odds Ratio; CI: Confidence interval; CSA: Central Statistical Agency; SWM: Solid waste management

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**Authors’ contributions**

GL, GA and AE conceived the study, GL collected the data, GL and MGF analyzed the data and prepared the manuscript, GA and AE read and edited the manuscript. All authors have read and approved the manuscript.
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Availability of data and materials
The datasets analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate
The study was ethically approved by the ethical review committee of Arsi University, College of Health Sciences. Formal letters were written to all concerned authorities and permission was secured at all levels. As the study didn’t include any invasive procedures we have collected only the informed verbal consent from each respondent after explaining the purpose and procedure of the study. Written consent was exempted by the research review committee of the college. The verbal consent was approved by the college research review committee.

Consent for publication
Not Applicable.

Competing interests
The authors declare that they have no competing interest.

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