The household garbage in the western coast region of Turkey and its relationship with the socio-economic characterstics

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Abstract: The aim of this study is to detect the daily amount of household garbage generated from districts within the limits of municipality of Aydin, the amount and contents of recyclable materials and to evaluate the effect of socioeconomic state. In this cross sectional survey, garbage was collected for one day from all of the districts, weighed both totally and after separation into groups. The districts were assessed according to literacy, drinking water sources and toilet indexes. For each district, three indexes were calculated viz. literacy, water and sewage index. Points between 1-3 were given and by adding points of each index, socioeconomic development (SED) score was calculated for each district. The daily amount of garbage produced was 0.91 ± 0.74 kg/person and recyclable material was 0.08 ± 0.13 kg/person (6.4%). A significant corelation was found between SED point and amount of recyclable materials ($p<0.05$). There was a positive, strong and significant correlation between workplaces in the districts and recyclable garbage ($r = 0.597$, $p<0.05$). In further analysis, number of workplaces increased the daily amount of garbage by 9.9 times ($p<0.001$; 95% confidence Interval : 4.538-15.189), whereas population 0.6 times ($p<0.05$; 95% confidence interval : 0.407-0.708).

Key words: Household garbage, Solid waste, Recycling, Environmental health

Introduction

Solid waste, produced in houses, gardens, parks, picnic places, *etc.* are not grouped as dangerous and harmful and are called household garbage (Bylaw of Control of Solid Wastes,1991). Solid waste management is used as an environmental health index Improper elimination of solid waste results in rapid reproduction of vectors, increase in vector born diseases, gastroenteritis and increase intestinal parasites (Yassi *et al.*, 2001).

In developing countries daily average of household garbage is estimated to be about 0.5-1 kg/person (Rouse, 2004). According to the Municipality Solid Waste Survey of the State's Institute of Statistics held in 2003, the average amount of solid waste in Turkey is 1.37 kg/person/day in summer and 1.38 kg annually (State's Institute of Statistics, 2004).

In Turkey, responsibility for collection, transport and elimination of solid waste is given to municipalities by legislations (Bylaw of Control of Solid Wastes,1991; General Hygiene Law,1930; old Municipality Law, 1930; new Municipality Law, 2004).

Aydin (area 3300 hectares) is a city on the western coast of Turkey, famous for its agriculture and tourism. The population of the city center is 143561 according to the state's census in 2000. Mediterranean climate is dominant in the city, average temp. is 17.6 °C and rainfall 677.5 mm/year. City is located in the first degree seismic zone. The literacy rate is 92.5%. Crude birth rate (1.24%) is lower than the national average. The population increase is related to immigration from the eastern region of Turkey for the last 30 years. The average household size is 3.5 persons in the city center (Evci *et al.*, 2005).

For over 15 years, the waste collected from Aydin has been eliminated in a valley, a former river bed, at the northeast part of the city, 25-30 m deep and 20-25 m wide. The area is an irregular dumping place. Besides household garbage, industrial solid waste from the three industry sites in the area, medical waste from health institutions, waste from military troops and neighbour municipality are also being dumped in the valley.

In the field where ground impermeability data is not provided, solid waste is randomly emptied and there is no system to collect rain water and leaking liquids or gasses. There is no plant for recycling, recyclable waste separated by workers of the subcontractor firm rented by the municipality by hand.

Dumping ground is very close to the central campus of Adnan Menderes University and there by bears risks to human and environmental health, damaging ecological balance. Fires generated due to uncontrollable methane and other gasses, result in air pollution. There is also a high probability of contamination of groundwater. The bad smell, resulting from the putrification of organic matter and mosquitoes causes discomfort to the inhabitants living in the area.

In Turkey, 65.7% of municipal solid wastes are eliminated in municipal dumping areas, 28.5% in landfills, and the rest is by ways of burrying or throwing into river, *etc.* (State's Institute of

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Table - 1: Garbage statistics of districts grouped according to SED scores and some influencing factors, Aydin, 2005

SED score of districts	Number of districts (n)	Literacy index*	Water index**	Sewage index***	Population (n)	Number of work places (n)	Mean household garbage (kg/person/day)	Mean household garbage (kg/house/day)	Ratio of recyclable waste (%) †
4	2	0.75	0.94	0.69	2629	223	0.77	2.93	7.12
6	8	0.81	0.99	0.95	41943	357	0.72	2.60	6.57
7	3	0.84	1.00	0.98	21728	631	0.87	2.94	5.58
8	5	0.85	1.00	1.00	40382	690	0.73	2.40	5.32
9	6	0.89	1.00	1.00	53888	1048	1.39	4.27	7.53
Total	24	0.83	0.99	0.92	160570	2949	0.90	3.03	6.42

* Literacy index = Number of people attending to primary school or over / Number of people seven years or older, ** Water index = Number of houses using tap water or bottled water/number of houses, *** Sewage index = Number of houses with a sewer / Number of houses † Weight of recyclable garbage/ weight of total household garbage

Statistics, 2004). Because of these reasons, waste management is one of the important environmental problems of municipalities. Few researches on the quantity and composition of garbage have been made in Turkey, but no data is found for settlements like Aydin.

The aim of the study is to determine the daily amount of household garbage, the ratio and contents of recyclable materials and to evaluate the socioeconomic characteristics on the quantity and quality of garbage.

Materials and Methods

The study is a cross sectional survey, performed during April-July 2005, in districts of Aydin Municipality, by Adnan Menderes University, Faculty of Medicine, Department of Public Health and Municipality of Aydin, Directory of Scavenging Services.

From all of the districts (n=24) were taken as the universe and per day's household garbage generated was collected. As all the waste of the municipality could not be collected in one day, a scheduled route for garbage trucks was developed without causing any malfunction in the routine scavenging services. As the frequency of trucks' waste collection varied (for some districts once a day, for others once in every two days), the daily average amount of garbage was calculated accordingly.

After household garbage was brought to the dumping area, it was weighed totally and then after separation into nine recycling groups (paper/cardboard, nylon/ plastic bags/sacks, wreck, tin, aluminium, glass, textile, hard plastic, pet) with a hand lever measuring with a sensitivity of 1 kg.

The data about population, education level, drinking water and type of toilet were received from Annual Household Survey of Directorate of Health of Aydin, population living in the city centre of Aydin was 160570. Workplace records were obtained from Licencing Services of Constabulary of Aydin Municipality. Number of workplaces was 2949.

The districts were assessed according to indexes derived from data of literacy, drinking water and type of toilet. Literacy index was calculated as the ratio of number of people attending to primary school or over to the number of people old enough to attend primary school. Water index was calculated by dividing the number of houses using tap water or bottled water into the number of houses. Sewage index was calculated as the ratio of the number of houses with a sewer to the number of houses. For each of the districts, these three ratios were calculated and the ranges of ratios were grouped into three according to cut off points of 33.3 and 66.6 percentiles. The ones under the 33.3% got 1 point (bad), those between 33.3% and 66.6% got 2 points (medium) and those above 66.6% received 3 points (good). For literacy index, the 33.3% and 66.6% cut off values were determined as 0.84 and 0.87; the districts with literacy index lower than 0.84 received 1 point, between 0.84–0.87, received 2 points; higher than 0.87, received 3 points. Likewise, 33.3% and 66.6% cut-off values for sewage index were 0.97 and 0.99 respectively. Thus, districts with sewage index less than 0.97, received 1 point; between 0.97 – 0.99 received 2 points; higher than 0.99 received 3 points. For water index, 33.3% and 66.6% cut off values were found 1.0 for both. The districts were given 2 points if water index was between 0.89-0.99 and 3 points if water index was 1.00.

Indices of districts are shown in Table 1. By adding points for three indices, a socioeconomic development (SED) score was computed for each district. The districts which had better socioeconomic state, had higher SED scores.

Some possible confounders were controlled in the measurements. As an example, the waste of market set in some districts were collected separately and not included. Besides, the schools were open during the analysis which was carried out in April and May, thus families were still in the city, and had not yet gone on holiday. Thus population was estimated close to midyear census. No other extraordinary occasion (holiday, fair *etc.*) took place during the period of analysis.

Table - 2: The components of recyclable household garbage in districts grouped according to SED scores, Aydin, 2005

Components	SED Score											
	4		**6**		**7**		**8**		**9**		**Total***	
	kg	%$	kg	%$	kg	%$	kg	%$	kg	%$	kg	%$
Paper	38	32.7	246	15.6	217	17.4	283	14.7	585	19.2	1369	17.3
Nylon	5	4.3	139	8.8	104	8.3	231	12.0	271	8.9	750	9.5
Wreck	2	1.7	30	1.9	31	2.5	58	3.0	67	2.2	188	2.4
Tin	17	14.7	102	6.5	102	8.2	151	7.8	193	6.3	565	7.1
Aluminum	2	1.7	8	0.4	9	0.7	13	0.7	21	0.7	53	0.7
Glass	8	6.9	308	19.5	238	19.1	353	18.3	665	21.8	1572	19.8
Textile	16	13.8	147	9.3	143	11.4	119	6.2	204	6.7	629	7.9
Hard plastic	17	14.7	298	18.8	195	15.6	331	17.2	540	17.7	1381	17.4
Pet	11	9.5	304	19.2	209	16.8	386	20.1	503	16.5	1413	17.9
Total**	**116**	**100.0**	**1582**	**100.0**	**1248**	**100.0**	**1925**	**100.0**	**3049**	**100.0**	**7920**	**100.0**

$ Percentage of columns, * Sum of rows, ** Sum of columns

Mean ± standard deviation, percentile values, Spearman's correlation, Kruskal-Wallis analysis of variance were computed in the analyses. p value less than 0.05 was accepted as significant. Factors affecting the amount of household garbage were assessed using linear regression analysis. In the regression analysis, p values and 95% confidence intervals (CI) were given. SPSS 11.5 statistical package program was used (Statistical Package for Social Sciences, Lead Technologies Inc., USA, Serial number: 12345678).

Results and Discussion

Daily amount of household garbage collected from the municipality borders of Aydin was 123190 kg and amount separated for recycling was 7920 kg (6.4%). Household garbage was generated 0.91±0.74 kg/person/day. First, per day's garbage amount per capita for each district was calculated. (Total weight of garbage for District A / Population of District A) Then sum of averages of each district were computed. The sum was divided into the number of districts. Recyclable portion was 0.08±0.13 kg/person/day (Initially, per day's recyclable garbage amount per capita for each district was calculated. (Total weight of recyclable garbage for District A / Population of District A) Then sum of averages of each district were computed. The sum was divided into the number of districts.) Daily amounts of household garbage and of recyclable materials were 3.05±2.16 kg and 0.25±0.37 kg per house respectively. Table 1 shows garbage statistics of districts grouped according to SED scores and some influencing factors. Percentages of household garbage (total and recyclable) of municipality according to SED scores of districts are shown in Fig. 1.

58.7% of population lived in the most developed socioeconomic conditions, namely in districts with SED scores of 8 and 9. Regarding the total of municipality, sewage index was found to have the widest range where water index was the highest. The districts of lowest SED scores were the regions where immigrants from the east have settled and built dwellings without an organized city plan.

There was no association between SED score and daily average amount of garbage generated per capita (p>0.05). A significant association was found between SED point and total amount of recyclable materials in the district (p<0.05). Amount of recyclable garbage increased as socioeconomic condition improves.
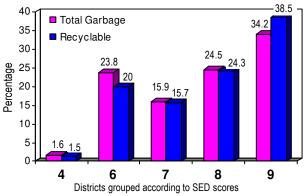

Fig. 1: Percentages of household garbage (total and recyclable) of municipality according to SED scores of districts, Aydin, 2005.
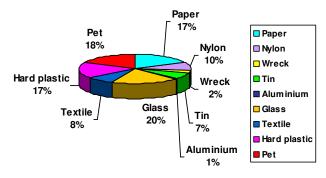

Fig. 2: Distribution of recyclable garbage, Aydin, 2005

The ratios of recyclable garbage groups are given in Fig. 2. The components of recyclable household garbage of districts according to SED scores are shown in Table 2.

Paper and hard plastic was generally the dominant group in garbage for districs with both high and low SED scores. The districts showed two characteristics about recyclable materials. In the districts with the lowest SED score, paper and tin was the dominant material. Glass (19.8%) and pet bottles (17.9%) made up the biggest portion of recyclable garbage in all other districts.

There was a positive, strong and very significant correlation between the number of workplaces in the districts and weight of recyclable household garbage (r = 0.597, p<0.05). Workplaces were generally located in socioeconomically developed district.

In further analysis, population of districts and number of workplaces effects household garbage. Number of workplaces increased the daily amount of garbage by 9.9 times (p<0.05; 95% confidence interval=4.538-15.189), whereas population 0.6 times (p<0.05; 95% confidence interval=0.407-0.708).

In developing countries daily average of household garbage is estimated to be about 0.5-1 kg/person (Rouse, 2004). In the current study, the average daily amount was found as 0.91 kg, which is in the normal range for developing countries. According to the state planning agency's five year progress report in 2000, average amount of solid waste generated in Turkey was estimated to be 0.7-1.0 kg/person/day (State's Planning Institution, 2000). These figures are lower than averages of developed countries. The generation of solid waste is known to be about 3.0 kg in the USA; and 1.5-2.0 kg in European countries (Sirin and Celebi, 2001).

In Turkey, researches of this kind performed by municipalities are limited in number. In the landfill zone located in Kemalpasa, average amount of household refuse was 0.61 kg (Isgenc, 2001), in Ismir metropol 0.5-0.8 kg (Sirin and Celebi, 2001) and in Istanbul about 1 kg according to statistics of the year 2000 (Sirin and Celebi, 2001). A simple study was done by the municipality of Aydin in the year 2004 and household garbage was found to be as 0.88 kg kg/person/day, in accordance with the current one (Municipality of Aydin, 2004). According to the state's institute of statistics' survey on Municipality solid waste statistics held in the year 2003, Turkey's production of solid waste was 1.38 kg/person/day (State's Institute of Statistics, 2004). This research was based on reporting of rough estimates of each municipality. Because industrial solid waste was also included, the average is thought to be overestimated.

The recyclable ratio of waste is expected to be 20-25% by private sector firms in waste management business. In this study, this ratio was found to be as low as 6.4%. In a survey made in Kemalpasa, recyclable ratio was found between 9%-20%

(State's Planning Institution, 2000). The amount and contents of recyclable refuse vary with respect to eating habits, traditions and some other factors like socioeconomical, climate (Amponsah and Salhi, 2004).

According to survey of the state's institute of statistics, organic matter makes up the biggest ratio of solid waste in Turkey (State's Institute of Statistics, 1994). However, in this study, no data was obtained because organic materials of waste were not sorted out for recycling. According to the same survey, about 12% of household waste in Turkey, is made up of paper and plastic bags (State's Institution of Statistics, 1994). Although such a grouping was not made in the current study; considering that glass, pet and nylon group is mostly used for packaging, at least 47% of garbage sorted for recycling is estimated to be of packaging materials.

In districts with high SED scores, the quantity of household garbage was seen to be more. In these districts, there were more restaurants and cafeterias, as well as houses and workplaces. Thus, packages of food and drinks are thought to increase the amount of total and recyclable refuse in these districts.

In the districts with high SED points, glass, pet, hard plastic and paper made up the bigger portion of recyclable waste. In such districts, it was estimated that more food and drinks were consumed and left overs (bottles, cans, paper, *etc.*) were thrown instead of being kept at home. The biggest portion of paper came from newspapers and package papers. Assessing that socio-economic state is correlated with the habit of reading newspaper and shopping, the result is in concordance with expected.

According to the pricing of the firms buying recyclable garbage, it was estimated to earn 1071 US Dollars a day and approximately 391.040 US Dollars annually by recycling. (calculated according to currency of 09/10/2005)

Data on the most essential indicator of socio-economic state, namely income level, could not be accessed on neither house nor at district level. With the presence of this useful data, which could be used as a direct index, it is thought that the SED scores could have been based on stronger evidence.

Garbage is a big problem for household if proper conditions aren't provided locally. Waste management starts buying a product and lasts until sorting out for recycling by household and its collection and elimination by municipalities.

In the current study, it was seen that the total and recyclable amount of household garbage increased as socioeconomic condition improves.Thus, the public awareness and sensitivity should be increased. By the help of starting recycling education at schools, awareness can be provided and good habits could be set at an early age.

Acknowledgment

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