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Public Perception of Dangerous Household Hazardous Waste Management: Pilot Study in Colombia

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Abstract: In this research, an analysis of the hazardous waste management residential (RPD) in the city of Barranquilla Colombia due to the lack of reports and research related to this subject, developed a questionnaire with 13 questions was developed which a once validated, it applied to a sample of 384 people differentiated by socioeconomic status whose results were evaluated statistically using Statgrahics Centurion 16. From this analysis, it was found that in the residential sector, 40% of the population does not understand the difference between an organic residue and a hazardous waste (RESPEL) and 84% of the population believes that in the city, not proper management of hazardous household waste (RPD) is performed, demonstrating the importance of strengthening the mechanisms of action on the management of this waste in Barranquilla.

Key words: Management, hazardous waste, population, strengthening, the importance, RPD

INTRODUCTION

The model of technological development and patterns of production and consumption worldwide, represent a key factor in the growing and varied production RESPEL hazardous waste (~400 million tons/year) (Eras *et al*., 2013) which are characterized by be corrosive, reactive, explosive, toxic, flammable, infectious or radioactive and in turn may cause risk or harm to human health and the environment (Couto *et al*., 2013. One of the main impacts caused by the improper handling of RESPEL is the affect on natural resources, promoting pollution in different matrices (soil, water and air) and/or compromised flora and fauna, likewise are generated public health problems by the emission of offensive odors and toxic nature compounds that can affect people. The RESPEL, can be generated from different sources such as industries, hospitals, commercial and residential sector where the waste generated within the houses which do not have a record for quantification and monitoring by the environmental authorities of each country.

According to RESPEL represent about 2/3 of municipal solid waste -RSU and the ability to quantify in relation to a rate of generation of hazardous waste domiciliary RPD is a complex task because not needed guidelines ordinary waste management in large cities which generates in landfills mixtures harmful to the environment (Slack *et al*., 2005). Among the reports on the identification, quantification, management assessment and management of RPD they have shown significant differences in different cities around the world. However, (Buenrostro and Israde, 2003) they found that in the city of Morelia-Mexico presented no significant differences in the proportion of type RPD with respect to the total amount of domestic solid waste generated in three high RSD social strata, medium and bass of this city. Moreover, Duan *et al*. (2008) in China they found that the generation of RPD per person daily is correlated to variables as custom and local culture, consumption patterns and urban lifestyle developed in the homes of its inhabitants and highlight the importance categorize the source of the RPD in homes as a management strategy and control in Chinese cities. In turn, Aprilia *et al*. (2013) reported that in the city of Jacata-Indonesia proper management derived from the absence of separation and disposal in landfills and inorganic waste generated in the RPD housing is performed. In the same vein, Gu *et al*. (2014) found that the most representative RPD in China include: cleaning products (21.33%), medicines (17.6%), personal cleansing products (15.19%), entertainment and education products (10.17%), home maintenance (10.97%) and batteries (11.14%) of which they were related to the daily needs of every house in the city of Suzhou. For its part, Otoniel *et al*. (2008), he reported that the city of

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Mexicali-Mexico produced 1.85-3.26 RPD tons/day per inhabitant and that this production is influenced by socioeconomic variables, finding that generation RESPEL house is inversely proportional to the level of income the lower income strata produces 3.2% of the RPD/day per capita while the middle and upper strata produce 2.6 and 1.04%, respectively. In a comparative study of the RPD between two areas in the United States-New Orleans, Louisiana and Marin County, California in contrast to the city of Mexico State that, although, the level of income was higher in the homes of America North, the three areas revealed similar percentages generation RPD: New Orleans 0.35, 0.4% for Marin County and 0.34% for Mexico City (Restrepo *et al*., 1991).

Colombia is no stranger to this problem, although, in the regulatory framework of the country's income RESPEL to landfills prohibits this has not been possible to control since there is no culture of separation in the country in the source. The aim of this study was to identify the management given to household hazardous waste in the city of Barranquilla, establishing the influence of socioeconomic status on the generation and management of these.

MATERIALS AND METHODS

Study area: This research Barranquilla, Department of the Atlantic-Colombia was made. This city has a population projection of 1, 213, 246 inhabitants it is located in the Northeastern point of the department, bordering on the west bank of the Magdalena River with an approximate area of 154 km^2, divided into 7, 611 blocks that make up 143 neighborhoods, making it the fourth urban center of Colombia and the first Caribbean Coast.

Measuring instrument: To identify the current management of hazardous waste at the household level in the city of Barranquilla, a questionnaire composed of 13 questions that respond to the identification and management of RPD was designed. The questionnaire was initially validated using the technique of expert judgment, for this, a group of five experts selected on the subject of waste management which assessed using a scoring system on a scale of 0-100, if each question answered to a specific objective related to the subject evaluated. A pilot thirty people from different strata was performed in order to identify questions that could lead to misinterpretation by respondents.

Sample size calculation: The number of sample size for the application of the surveys was calculated according to the equation suggested by Gutierrez and Salazar (2004), applying equation derived from the calculation of Confidence Intervals (CIs) for a population proportion when variability is unknown. The equation used was:

$$n = \frac{Z^2_{\alpha/2} N \bar{p}(1-\bar{p})}{e^2(N-1) + Z^2_{\alpha/2}\bar{p}(1-\bar{p})} = \frac{(1.96)^2(1'213.246)(0.5)(0.5)}{(0.05)^2(1'213.246-1) + (1.96)^2(0.5)(0.5)} \cong 384 \quad (1)$$

Where:

n = Sample size

$Z^2_{\alpha/2}$ = Value corresponding to the Gaussian distribution

1.96; $\bar{p}$ = Expected prevalence of parameter to assess

e = Error expected to commit = 5%

Table 1: Categorization on waste generation options

Variables	Values
Not generating the waste	1
It generates but does not identify hazardous characteristic	2
It generates and identifies hazardous characteristics	3

A total of 384 people were surveyed by stratified sampling taking into account the socioeconomic strata of the city reported by the Dane.

Recognition on the management of RPD: Concerning the knowledge of people on the RPD were asked based on a list of options that products generated in their homes; in addition, you will be asked about their perception on the hazardous characteristic such as corrosive, flammable, toxic, radioactive, explosive, reactive and infectious. The validation of the response was compared with four other options are not relevant to RESPEL (e.g., vegetable waste, cardboard boxes, containers and packaging gas preserves and sauces). Established the RPD generated and identified based characterization was implemented to Table 1.

Analysis of the information: IC were calculated with 95% confidence. The correlation of the questions with the selected layer was performed using ANOVA and multiple comparison test when these conditions were met and in cases where these conditions were not met, Kruskal-Wallis tests were applied (Gutierrez and Salazar, 2004).

RESULTS AND DISCUSSION

It was found that 50% of the population classified organic waste (food scraps) and inorganic (beverage containers, cans, paper, cardboard, etc.) and the other

50% does no separation at source. These results are in line with those reported in the report which states that the percentage of citizens engaged in recycling and reuse practices is very low with approximately, 50% in all cities. According to χ^2-test ($p = 0.0002$) significant differences between the layers 5 and 6 with greater separation at source, compared to levels 1-3 were presented.

Recognition on the management of RPD: Given the categorization of the RPD according to the characteristic of danger, grouped into three groups it was identified that the packaging of detergents and disinfectants are related and grouped separately in a single cluster (group A) with a representation most recurrent generation by the population. In group B, wastes according the highest percentage of respondents not generate in their homes, in addition, this group is comprised of the largest amount of waste (12 of 23 in total list) were pooled. Finally, the C group has residues that show a similar behavior to group A but the proportion of generation changed finding smaller percentage in non-waste generation.

According to Inglezakis and Moustakas (2015), in cities in Belgium, Holland and New Zealand the RPD, most are collected are those for paint containers, oil and batteries, in this research were grouped in cluster B where the option with the highest percentage response was not generation. In cities of Japan on the other hand are batteries which represent 50% of RPD collected while for Barranquilla represent only 12% of generation and identification as dangerous. As can be seen, the behavior is not the same in many cities, so set a percentage of generation and be consistent globally would be ill advised, since, each country has regulations and categorizations of different RESPEL and this can affect the generation percentage by country. In the case of fruit and vegetable waste 75% of the population identified it as non-hazardous waste, however, 25% he considered RESPEL; similar happened with waste cardboard boxes and packaging preserves and sauces where 84% of the population considered it as non hazardous waste, these results can be attributed to that while they conducted surveys and seeing the toxic option, thought that waste as fruits and vegetables consumed could lead poisoning. Regarding the knowledge possessed by the population surveyed on the hazardous characteristics of the four ordinary waste (They are not RPD), 40% of the population considered to present any hazardous characteristics, indicating that there is a lack of knowledge about a RESPEL and an ordinary waste (organic/inorganic). This is consistent with Al-Khatib *et al.* (2015), an analysis of public perceptions about the dangers regarding the management of solid waste in Palestine found that 51% of the surveyed population does not know the concept of RESPEL in contrast with 48.6% saying if I recognize it. In the same vein (Zeng *et al*., 2016) reported the difficulty of establishing the difference in the concept of RESPEL in a rural area because the people conducting inadequate RPD mixtures with RDM. The χ^2-test showed significant differences in the generation of RPD in relation to the socioeconomic status of the city ($p>0.05$). In this sense, disinfectant residuals generated healthcare, packaging contaminated with chemicals, waxes, car batteries, contaminated fuel containers, packaging brake and transmission fluids and toiletries and cleaning of furniture $p = 0.0066$, 0.0300, 0.0169, 0.0007, 0.000, 0.0074, 0.000 and 0.0146, respectively. In relation to the generation of waste as hazardous by unidentified each stratum the χ^2-test showed significant differences in the generation of packaging of detergents and bleaches, disinfectants packaging, enamels, used X-rays $p>0.05$ 0.0255, 0.0324, 0.022 and 0.03, respectively. In the generation of other waste there were no significant differences because the test showed a $p>0.05$.

Regarding the public consultation on whether it would reduce the amount of waste mentioned at the cost of payment for waste generated, 46% of respondents said they would be willing in contrast to 33% would not. This demonstrates that a monetary factor resulted in a tax for polluting can trigger a positive reaction to the reduction of generation RESPEL in their homes. Regarding the need for training, for proper management of the RPD and how this could help make a proper waste management, the average assessment of the importance described by the population surveyed was 4.6 of 5.0, indicating that people believe they are convenient trained in handling RESPEL generated at the household level, this is consistent with the reported by Guerrero *et al.* (2013) which established the importance of training to various stakeholders including the sector house, in the management and classification of waste in order to achieve a sustainable model in cities in developing. Regarding the perception of people in different strata on the recognition of facilities authorized to receive RESPEL, the χ^2-test showed significant differences only for option no (p-0.0464, however, the options yes). I do not know and I'm not interested no significant differences. It analyzed whether there are differences between strata in recognition of authorized facilities for receiving hazardous waste for this the Chi-square that fearlessness that significant differences exist only for option no with $p = 0.0464$ was used, the yes options ($p = 0.1118$), I know ($p = 0.3766$) and I do not care ($p = 0.6280$) showed no significant differences. Strata showed differences among them were

two and six, taking the first higher proportion of people who say not recognize accredited for waste disposal sites, the other layers (1, 3, 4 and 5) were similar between them while maintaining a high proportion of people who are unaware of these sites.

CONCLUSION

The most recognized as RESPEL residues were containers of bleaches and disinfectants which showed statistically significant differences in the identification of risk stratum were: waste packages of disinfectants, resulting from medical care, contaminated chemicals containers, car batteries used contaminated with fuel containers brake and transmission fluids, toiletries and cleaning of furniture containers, corresponding to 30% of all waste presented in the survey. The 70% of the population provides that waste should not be classified in the same way.

The 50% of the population were established that separation of waste into organic and inorganic. The 46% of the population would be willing to reduce their RPD should have to pay for the provision of these. The 84% of the population believes that in Barranquilla proper management of the RPD is not performed. Finally, there is a deficiency in knowledge and identification of a house RESPEL, since, 40% of the population, did not identify the characteristics of hazardous waste in relation to ordinary RPD.

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