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# RELATIONSHIPS BETWEEN REGION, FREQUENT CLEANING AREA, STORAGE LOCATION, LEGAL REGULATION, AND CLEANINIG SUBSTANCE POISONING: A CROSS-SECTIONAL STUDY

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***Abstract:*** *This study was undertaken to investigate an indoor threat, namely that of household cleaning substances in nine different areas of the city of Aydin, in western Turkey. A stratified sampling method was used to reach 603 participants. Study instruments included a questionnaire and a checklist. Results show that 14.4% of the participants cited experience with poisoning due to cleaning substances in the preceding year. Health care region, cleaning location, and cleaning substance storage place all have statistically significant relationships to poisoning ($p<0.05$). The Aydin study finds that consumers' use of products according to specifications set forth by legislation is low and highlights the importance of raising awareness and creating educational interventions targeted at consumers.*

***Key words:*** *cleaning substances, poisoning, awareness.*

## 1. Introduction

Chemicals in different models of household cleaning substances are part of daily lives. They are used to clean and stored in many locations in every community. Sometimes users forget how dangerous they can be, a health and environmental threat. It's important to handle, store, and dispose of them safely. Household cleaning substances create risks for child environmental health due the various potentially hazardous types of chemicals and solutions, areas of use and storage locations. The vast majority of poisonings occur in children aged 0-6 years; records of home accidents as a result of cleaning agents stored in locations that can be reached by children are common knowledge. Most cases of poisoning in children aged 1-2 years occur due to unsafe storage of medicines and cleaning products. According to the 2008 Report of the American Association of Poison Control Centers, *"children younger than 3 years were involved in 38.7% of exposures*

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*and children younger than 6 years accounted for half of all human exposures [1].”* According to the Ministry of Health (Refik Saydam National Public Health Agency) National Poison Information Center’s (NPIC) 2008 Working Report for Turkey, the household cleaning substances group makes up 7.57% of NPIC case records. The household cleaning substances group accounted for 5900 cases Involving 6125 different chemicals. Children younger than 3 years of age were involved in 25.9% of exposures, and children younger than 6 years of age accounted for approximately 35.0% of all human exposures [2].

The parents who do not store their cleaning substances in a child-safe manner perceived their child to be more vulnerable to possible unintentional poisoning than parents who do store their products in a safe manner. In Netherlands study cleaning products was reported to be stored in a child-safe manner by 60.5% of the respondents [3]. In addition to children and parents, cleaning workers are also at risk of exposure of chemicals compounds of cleaning substances [4]. Prior research on dangers posed by household cleaning substances and poisoning in households considers the relationship between substance type and poisoning [5-9]; however, more recent studies have focused on the relationships between storage factors, usage methods, and poisoning [10-17].

## 2. Objectives

The aim of our study, carried out with the adults living household, to determine the relationship between region, frequent cleaning area, storage location, legal regulation, and cleaning substance poisoning.

## 3. Material and Methods

### 3.1. Sample and setting

This population-based cross-sectional descriptive study was carried out between 24 September 2007 and 5 January 2008 in Aydin, a city in Western Turkey with a population of 217,558.

Power was calculated according to the outcome of a pilot study carried out in 150 households related to “to determine relationships between health centers and poisoning.” A sample size of 565 achieves 90% power to detect an effect size (W) of 0.1838 using a Chi-square test with eight degrees of freedom and a significance level (alpha) of 0.05. Stratified sampling was used for sample selection. In Aydin, there were nine health care center (HCC) regions. All of the health care center regions in the city center were selected as layers. In HCC-6, all households were included the study because of unestimated population in the region. Sample size was determined to be 603 include HCC-6. Participants of the study were selected with a simple random sampling method using “household health identification cards (HHIC)” in health care centers. One of citizens above 20 years old from each household was accepted as a respondent of the study. Inclusion criteria for the study were that the individual did not have a communication problem, did not have a perception problem (schizophrenia, etc.), and agreed to participate in the research.

### 3.2. Characteristics of the research region

There are nine HCC regions in the Aydın city center. Characteristics of the HCC regions were described below. HCC-1 consists of an older settlement pattern, a marketplace and is middle class socio-economic and cultural in character. HCC-2

is a region where primary and secondary schools and the university and state hospitals are located; it is more heterogeneous in terms of socio-economic and cultural characteristics than the other HCCs. (Because they didn't have statistical data about household and population, HCC-2 wasn't included to the study). HCC-3 and -5 are in the southern part of the city, which is composed of both rural and urban settlements (HCC-5 includes industrial and commercial businesses). HCC-4 is an industrial region with migratory characteristics. HCC-6 is an underdeveloped region in terms of socio-economic and cultural capital, and is populated mainly by "Roma" citizens. HCC-7 and 9 are urban settlements and intermediate-upper level in terms of social, cultural and economic indicators (HCC-7 is in a region where shopping centers located; HCC-9 is in the western region of the city, in an area characterized by new development. HCC-8: In the migration-receiving region; mostly rural and underdeveloped in terms of socio-cultural and economic capital.

### 3.3. Questionnaire and control list

For this study, we prepared and used two research instruments. The first is a questionnaire prepared with reference to previous studies and developed through pretesting with sample of 20 subjects [10,11]. This questionnaire consists of closed-ended questions examining the sociodemographic characteristics of participants (9 questions), experience with poisoning due to household cleaning substances (3 questions=*Was there a poisoning caused by household cleaning substances in your home? If yes, who was poisoned?, If your child/children was/were poisoned, how old was/were she/he/they?*), and usage areas and storage locations for household cleaning substances (two questions= *In which section do you keep household cleaning substances in your home? Which part of your house is cleaned more than twice a day?*).

The second tool is a checklist prepared to inspect the labels of household cleaning substances using each of the items in the Ministry of Health's two legislative communications on labeling: "TSHGM number 2005/2 Communiqué on Labeling Chlorine-based Bleach and Cleaning Powder" and "TSHGM number 2005/3 Communiqué on Properties of Laundry Detergent with Packaging and Labels." [18,19]. The checklist reliability was measured and found as a high reliability coefficient of alpha=0.950 to use in the study. Substances were grouped as either "eligible," meeting any of the eligibility criteria for regulation (production place, amounts of active and additive ingredients, usage area, instructions for use, production date, warnings) in the legislation, or "ineligible," meeting none of the criteria in the legislation. This process was performed separately for chlorine-based bleach, cleaning powder and laundry detergent.

### 3.4. Procedures

This study was approved by the ethical committee of the Medical Faculty of Adnan Menderes University (26.08.2008, Convenience Approval Number VI). Twenty final-year students from the School of Health were trained for data collection for two weeks. Questionnaires were administered following receipt of written informed consent from the participants the questionnaire was conducted. If individuals were not found at home on the first visit, a second home visit was attempted. Students completed the questionnaire in participants' homes during face-to-face interviews. Interviews were conducted during the daytime, frequently during the afternoon and on weekdays. Checklists were filled out by the

interviewer, who was instructed to check all cleaning substances individually. Non-legislative household cleaning substances were not inspected. As detailed chemical contents such as alkali-acid, corrosive etc. are not required in the legislation this information was excluded by the study.

### 3.5. Statistical analysis

For data identification, number and percent were used. Factors that might affect poisoning were determined by chi-square analysis and factors related to poisoning were examined by multiple correspondence analysis. PASW Statistics version 19 for Windows was used for statistical analysis.

## 4. Results and Discussions

All of 603 adults participated to the study. The mean age of participants was 39.36±11.36 (20-82) years; 91.2% were married, 88.1% had children, and 47.7% had a child under six years old. The participants' demographic characteristics are shown in Table 1.

Table1

*Demographic characteristics of study participants, Aydin, 2008*

| Characteristics | n | % |
|---|---|---|
| Gender (n=603) | | |
| Female | 562 | 93.2 |
| Male | 41 | 6.8 |
| Education (n=596) | | |
| Primary school or lower | 390 | 64.7 |
| Secondary/high school or beyond | 206 | 34.2 |
| Marital status (n=603) | | |
| Married | 550 | 91.2 |
| Single/Widow/Divorced | 53 | 8.8 |
| Occupation (n=600) | | |
| Currently employed | 127 | 21.2 |
| Unemployed* | 473 | 78.8 |
| Residence (n=603) | | |
| Rural | 90 | 31.5 |
| Urban | 13 | 68.5 |
| Social security (n=600) | | |
| Yes | 69 | 94.8 |
| No | 31 | 5.2 |

*Housewife, retired or out of work

Eighty-seven (14.4%) participants stated that they had experienced poisoning due to cleaning substances in the preceding year. Of the participants who experienced poisoning, 71 were adults and 16 were children. It was determined that 14 of the poisoned children were 6 years old or younger when they were poisoned.

When the distribution of poison exposure is examined by health care center region, the poisonings are clustered in health care centers six (25.0%), four (22.8%) and seven (18.8%).

The washbowl (36.4%), toilet room (the room in which the toilet is located, not the 'bathroom') (17.1%) and bathroom (14.3%) are the rooms most frequently associated with poisoning. Respondents with history of poisoning also reported that cleaning substances are stored in toilet room (29.5%) and the kitchen (17.2%). The health care center region, cleaning location, and cleaning substances storage location (toilet room and kitchen) all have statistically significant relationships with poisoning ($p<0.05$) (Table 2). Using multiple correspondence analysis, it was determined that poisoning appeared in health care centers one, four, six and seven, among respondents who frequently clean the toilet and sink, and in households where cleaning substances are stored in the toilet and kitchen (Figure 1).

Interviewers checked chlorine-based bleach, cleaning powder and laundry detergent separately using the checklist. Health care center number one is notable for its use of legislation-appropriate chlorine-based bleach (61.5%), cleaning powder (65.4%) and laundry detergent (51.9%) (Table 3). There was a statistically significant relationship between regulatory compliance for cleaning substances and health care center region ($p<0.05$).

Table 2

*Distribution of poisoning cases by health care center region, frequently cleaned spaces and storage location of cleaning substances, Aydin, 2008*

| | | Poisoning n (%) | | Total | Chi-Square | p |
|---|---|---|---|---|---|---|
| | | No | Yes | | | |
| Health Center Region | 1 | 49 (94.2) | 3 (5.8) | 52 | 19.849 | 0.006 |
| | 3 | 27 (90.0) | 3 (10.0) | 30 | | |
| | 4 | 44 (77.2) | 13 (22.8) | 57 | | |
| | 5 | 66 (93.0) | 5 (7.0) | 71 | | |
| | 6 | 15 (75.0) | 5 (25.0) | 20 | | |
| | 7 | 182 (81.3) | 42 (18.8) | 224 | | |
| | 8 | 59 (95.2) | 3 (4.8) | 62 | | |
| | 9 | 74 (85.1) | 13 (14.9) | 87 | | |
| Frequently cleaned spaces | Kitchen | 226 (88.6) | 29 (11.4) | 255 | 13.369 | 0.020 |
| | Bathroom | 58 (86.6) | 9 (14.3) | 67 | | |
| | Toilet | 165 (82.9) | 34 (17.1) | 199 | | |
| | Washbowl | 7 (63.6) | 4 (36.4) | 11 | | |
| | Living room | 40 (93.0) | 3 (7.0) | 43 | | |
| | Other | 20 (71.4) | 8 (28.6) | 28 | | |
| Storage of cleaning substances in toilet | No | 485 (86.8) | 74 (13.2) | 559 | 7.515 | 0.006 |
| | Yes | 31 (70.5) | 13 (29.5) | 44 | | |
| Storage of cleaning substances in kitchen | No | 237 (89.1) | 29 (10.9) | 266 | 4.792 | 0.029 |

Multiple correspondence analysis shows that while households in health care center regions three, four and six tend to buy cleaning substances that do not comply with regulations, households in health care center one tend to buy cleaning substances that do comply with regulations (Figure 2, Table 3).

Houses, where people spend most of their time, cleaning substances present an "indoor risk factor." The Aydın study was designed to show significant relationships between four impact factors in the houses, and cleaning substances poisoning. The study was based on individuals (one adults living in the household), not on households. As a limitation of the Aydın study, data was collected mostly on weekday afternoons. Thus, most participants were women (93.2%) and individuals who were not employed (78.8%) as mentioned in Table 1. Of the 603 participants, 87 individuals had been poisoned with household cleaning materials. Poisoning results were examined by region, frequent cleaning locations within the house, cleaning substance storage location, and accordance with legal regulations. On the other hand, we didn't answers detailed questions on poisoning such as "In what way can they be poisoned? Did they use non-legislative cleaning substances? How is poisoning defined? What is known about the health status among the adults and usage behaviour of drugs and medication? Is there any relations with medication and present poisoning?".

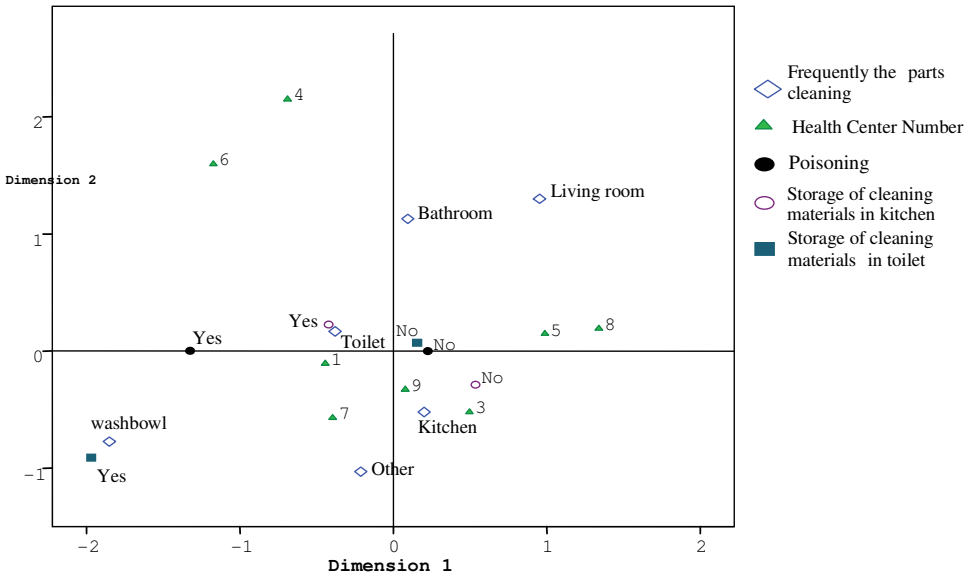


Fig. 1. *Multiple correspondence analysis showing the relationship between poisoning and health care center regions, frequently cleaned areas, and storage locations*

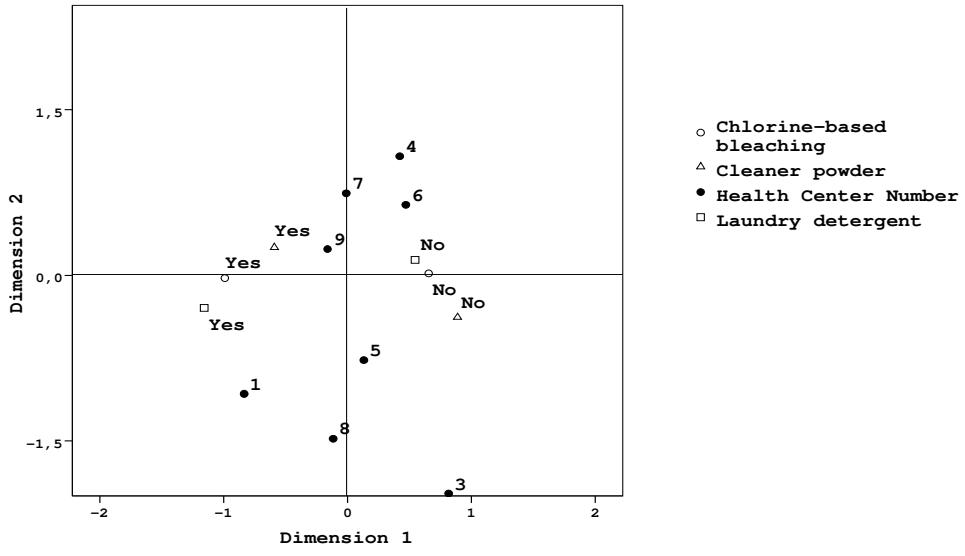


Fig. 2. *Multiple Correspondence Analysis showing the relationship between cleaning substances, regulatory compliance and health care center regions*

Table 3

Distribution *of usage of cleaning substances in compliance with regulation according to health care center regions. Aydin, 2008*

| | | **Health Care Center Number** | | | | | | | | **Chi-Square** | **p** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory Compliance (%) | | 1 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| Chlorine-based bleach | No (n:363) | 38.5 | 73.3 | 68.4 | 73.2 | 55.0 | 61,2 | 53.2 | 56.3 | 21.179 | 0.004 |
| | Yes (n:240) | 61.5 | 26.7 | 31.6 | 26.8 | 45.0 | 38.8 | 46.8 | 43.7 | | |
| Cleaning powder | No (n:241) | 34.6 | 66.7 | 38.6 | 42.3 | 50.0 | 35.3 | 50.0 | 35.6 | 15.917 | 0.026 |
| | Yes (n:362) | 65.4 | 33.3 | 61.4 | 57.7 | 50.0 | 64.7 | 50.0 | 64.4 | | |
| Laundry detergent | No (n:410) | 48.1 | 76.7 | 84.2 | 60.6 | 90.0 | 70.5 | 59.7 | 66.7 | 26.361 | 0.0004 |

According to the NPIC 2008 Working Report, 7.6% of poisoning cases involve household cleaning substances. Aydın ranks 29th in the NPIC when phone inquiries are sorted by city; 826 calls were made in 2008. The 2008 Annual Report of the American Association of Poison Control Centers National Poison Data System stated that that 8.6% of poisoning cases involve household cleaning substances. Thus, data from the U.S. supports that of Turkey. However, the NPIC report includes no data about household cleaning material poisoning for provincial level. Considering the Turkey-wide rate of 7.6%, we expect that 63 of those cases took place in Aydın. In the present study, it was seen that 87 people poisoned in the last year.

Most of papers published in the literature indicate the cleaning products are associated with children health effects. In these studies, findings typically implicate unsafe storage of cleaning substances (e.g., unlocked, easily accessible storage below the mother's eye level) and storage in containers other than the original packaging (e.g., empty water bottles, beverage bottles, etc.) [10-13]. There is lack of detailed community-based studies of adults affected by household cleaning substances.

The Aydın study, with multiple correspondence analysis, yields interesting results. In the regions associated with health care centers number one, four, six and seven, poisoning was seen in those who frequently clean the sink and toilet and store cleaning substance in the toilet room and kitchen. Health care center regions number one, four and six stand out in that hese regions differ from one another in terms of socio-economic and cultural structure, immigration levels, and proximity to the city center. While health care centers number six and four are underdeveloped regions where mostly "Roma" citizens live, health care center

number one is in the city center and at anintermediate level in terms of its socioeconomic and cultural characteristics. Given this diversity, we can that the specific regions have no effect on poisoning incidence. On the other hand, methods of cleaning substance use and storage are important. Some research refers to improper storage of cleaning substances [10-13]; however, previous research did not associate poisoning with specific storage areas such as the kitchen and toilet. As limitation of the study, nine regions were included but some had low numbers of participants. The descriptions of the regions were rather qualitative and in the future studies, re-grouping could be made on the basis of more objective, perhaps semi-quantitative information.

In Turkey, market inspection and monitoring of household cleaning substances is the responsibility of the Ministry of Health. The Ministry prepared the legislation on chlorine-based bleach, cleaning powder and laundry detergent. Legislation includes rules about required labeling (Appendix 1). Despite national Turkish legislation involving education and efforts to raise public awareness, only 10 consumer complaints about labels were received. The low number of complaints has been associated with consumers and manufacturers not understanding the complaint mechanism [12]. In communication networks such as those seen on the internet, it is generally understood that "consumers need easily comprehensible labeling and packaging that contain visual warnings rather than written ones." The relationship between proper use of cleaning substances and health care center regions was examined in the Aydın study. Because 64.7% of the participants have primary school or lower education levels, they would not be expected to read detailed information about product storage, corrosive agents and amounts of added ingredients, areas for use, instructions for use, and production date on the label.

It is a reality that labeling alone can't be sufficient to prevent poisoning. In addition to labeling, legislative harmonization, monitoring, assessment, training, increase awareness etc. should be used as poison prevention tools. According to the results of this study, regulatory compliance for the cleaning substances used by participants was 39.8% for chlorine-based bleach, 60.0% for cleaning powder, and 32.0% for laundry detergent. Participants who use substances violating regulatory rules are more likely to live in health care center regions number three, four and six. Common characteristics of these health care centers are distance from the city center, higher concentration of migrant residents, and socioeconomic as well as cultural underdevelopment. References comparing the relationship between regulatory compliance and settlement regions could not be found. Studies about legislation mostly pertain to European Union and American public enterprises and legislative arrangements [20-23].

The patterns of poisoning according to storage and frequently cleaned places have well been randomly scattered. In addition, these were based on the current situation, while the poisoning could have taken place many years before. The time window for poisoning in the questionnaire were designed as "ever", which was very inclusive but at the same time could be a drawback because of the large age range.

## 5.Conclusions

Results of this study point to the importance of raising awareness and designing educational interventions targeted at consumers. Future data collection, especially in cities, and detailed analysis should shed light on the most

appropriate approaches to raising awareness. Education programs should encourage consumers to buy cleaning products with comprehensible labels, avoid products without labels, use products properly in the most frequently cleaned places in the home, and store products safely. It is important that labeling includes clear, pictographic warnings rather than written warnings, especially for mothers with low levels of education.

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