Epithelial Micronuclei Occurrence Among the School Children in the Province of Cavite, Philippines

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ABSTRACT

The problem of pollution emanating in the environment is a pressing environmental health problem as it brings about numerous problems to people who are exposed to it. Children are one of those individuals who are vulnerable and sensitive to these harmful pollutants emanating in the environment. In assessing their exposure to the harmful pollutants especially to genotoxicants in the environment, this study aimed to assess the epithelial micronuclei occurrence among the school children in the province of Cavite. Consenting public and private school children of the municipalities of Bacoor and Alfonso were involved in this study. Smears of the exfoliated epithelial cells from the buccal mucosa were prepared. A total of 911 consenting school children participated in this study. The prevalence of epithelial micronuclei occurrence observed among the school children in the province of Cavite was 20.5%. School children in the urban areas showed more micronuclei occurrences compared with those school children in the rural areas. More epithelial micronuclei occurrences were observed among those studying in public schools compared with those in private schools. Females had more epithelial micronuclei frequencies compared with males. Despite the results, no significant differences on the epithelial micronuclei occurrences of the school children living in urban and rural areas and those studies in private and public schools in Bacoor and Alfonso and gender ($p > 0.05$).

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INTRODUCTION

The problem of air pollution emanating in the environment is a pressing environmental health problem as it brings about numerous problems to people who are exposed to it. Children are one of those individuals who are vulnerable and sensitive to the harmful pollutants present in the environment. The rising concern of the unabated environmental condition tends to cause a toll in the lives of those who are exposed to the harmful substances as it may bring about long-lasting and expensive health problems especially among our young populace. Studies [1,2] have presented that numerous morbidities and mortalities arise from one’s exposure to harmful substances like genotoxicants released from emissions generated from motor vehicles, industries, and the domestic sector.

The possibility of determining the significant effect of air pollution to the young populace can help bridge the gap on our understanding of the importance and the complex relationship that exists between the environment and human health. Studies have presented that the deteriorating air quality poses numerous impacts to our health, especially among the young populace, as it may result from a subtle biochemical and physiological change [3] to an aggravating respiratory and cardiac condition [2] and even as worse as cancer [4]. In the Philippines, there are limited studies that looked into the condition and the susceptibility of the vulnerable groups like the children to the emanating pollutants that build up in the environment. In assessing people’s exposure to the harmful environmental pollutants, biomonitoring techniques have been used as an indicator of chemical exposure. According to LaKind et al. [5] and Jyoti et al. [6], buccal epithelial cell monitoring has increasingly become a common tool in measuring chemical exposure as the cytogenetic damage brought by environmental pollutants can be monitored through the use of the exfoliated buccal cells [7].

With these concern, this study aims to assess the epithelial micronuclei occurrence among the school children and compare whether differences exist among the school children based on their socio-demographic and location on the occurrence of buccal epithelial micronuclei. The result of this study is vital, as it provides...
baseline information on the cytogenetic damage on the children’s exposure to their environment and the factors that contribute to their chemical exposure of the children. This study is likewise significant because the valuable information generated can provide an indication of the health condition of the school children that can bring awareness and realization among the concerned sectors and departments of the government to concretize necessary measures to safeguard the welfare of the general populace.

MATERIALS AND METHODS

The province of Cavite is part of the CALABARZON region in the Philippines. Two municipalities from Cavite were selected as the study sites. The municipality of Bacoor represented the study area that is urban and congested, with a traffic volume of >20% and high vehicular density, whereas the municipality of Alfonso represented the study area that is rural and uncongested, with a traffic volume of <20% and low vehicular density. The municipality of Bacoor is a first-class urban municipality, whereas the municipality of Alfonso is an upland rural municipality. Both public and private schools of the municipalities of Bacoor and Alfonso were selected as the study sites. The study subjects were composed of preparatory, primary, and secondary school children. The selection of the study subjects were based on an inclusion-exclusion criterion set by the investigators. Respondents who expressed their willingness to join the study, provided their informed consent, were willing to provide buccal exfoliated epithelial cells, and were willing to be interviewed were included in the study. The approval of the conduct of this study was secured from the ethics committee of the institution where the author is connected and from the public and private school administrators. Letters of informed consent were sent to the parents of the school children who volunteered, and the parents and the school children were informed of the objectives of the investigation. All subjects and their parents gave their informed consent.

The interview schedule used in the study provided the information pertaining to the socio-demographic factors such as age, gender, and educational level. The exfoliated buccal epithelial cells were obtained by scraping the inner cheeks using a sterilized wooden tongue depressor after the mouth was moistened with water. Buccal exfoliated epithelial cells were smeared on a labeled microscope slide, air dried, fixed with 1:9 formalin/ethanol solution, washed with 0.1 M phosphate buffer solution (pH 7.5), and stained using a modified procedure of the Feulgen reaction. The smeared cells were stained with fresh Schiff’s reagent for 45 min and washed with tap water for 15 min and counterstained with methylene blue for 2 min and rinsed with distilled water for 30 s. In the stained slides containing the smears, 1,000 cells per individual were examined under light microscopy at 400× magnification. The presence of micronuclei in each cell was confirmed under 1,000× magnification.

The cells were scored based on three distinguishing features of a micronucleus, and the results were reported as the frequency of cells containing a micronucleus [13,14]. The micronuclei were identified according to the following criteria: micronucleus is distinctly separated from the parental nuclei; size of micronucleus is smaller than one-third the size of the main nuclei; and if there were more than two micronuclei present in a cell, the micronuclei were not counted. Only cells with intact nuclei that do not overlap and clump were included in the analysis.

Results of this study were analyzed for significant differences between the public and private schools in both the municipalities using the t test. A test with a \( p < 0.05 \) indicates that all statistical analyses are significant. All statistical analyses were performed using the Statistical Package for Social Sciences software.

Results:
A total of 911 school children gave their informed consent and their parents' informed consent. Of the total number of school children who participated, 649 were elementary and 262 were high school students. About 500 school children lived in the municipality of Bacoor and 411 school children lived in the municipality of Alfonso. There were more girls (59.7%) than boys (40.3%) who participated in the study. The mean ± SD age of the respondents was 10 ± 3 years. Table 1 presents the socio-demographic and personal information of the respondents.

<table>
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<th>Table 1: Socio-demographic profile of respondents.</th>
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<td>Location</td>
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The prevalence of school children that had epithelial micronuclei in their stained buccal smears is 20.5%. Most of the students (79.5%) have no micronuclei observed in their smeared buccal exfoliated epithelial cells. The proportion of school children that reside in the urban areas (61.7%) had more epithelial micronuclei seen in their buccal smears as compared with those seen in the rural areas. More epithelial micronuclei occurrences were observed among those school children that were studying in public schools (66.3%) as compared with those studying in private schools (33.7%). There were more elementary school children that had epithelial micronuclei occurrences (70.6%) than those who were in high school (29.4%). There were more females (65.2%) than males (34.8%) who had epithelial micronuclei occurrences. More elementary students (61.8%) had more epithelial micronuclei frequency compared with high school students. More epithelial micronuclei frequency was observed among the 7-year-old students (15.6%). More epithelial micronuclei frequency was observed among those school students who commute by walking (52.6%) and taking public transport (33.1%) than those taking air-conditioned vehicles (14.3%).

Results of the unpaired t test showed that the mean epithelial micronuclei occurrences of the school children at both study areas were not significantly different ($p > 0.05$). Likewise, no significant differences were also observed among those school children's mean epithelial micronuclei occurrences to those studying in public and private schools, and no significant differences were observed in the micronuclei occurrences of school children living in Bacoor and Alfonso and in the gender of respondents ($p > 0.05$).

**Discussion:**

This study was cross-sectional in nature. Children who were studying in schools are those who are represented in this study. Results of the study have shown a low prevalence of epithelial micronuclei occurrences among the school children examined. No significant differences on the epithelial micronuclei occurrences among those school children that were studying in public schools and private schools and in the municipalities of Bacoor and Alfonso. Since no differences were observed, the likelihood of epithelial micronuclei occurrence may occur to any individual whether one is living in an urban or a rural area, one is studying in public or private schools, and one is a female or a male. The result of our study has likewise showed that children who traverse the streets in a high vehicular density had equal chances of epithelial micronuclei occurrences to those who traverse area that has low vehicular density.

Although higher occurrences of epithelial micronuclei were observed among the female schoolchildren, no significant difference on gender indicating that males and females do not significantly differ in terms of their occurrences of epithelial micronuclei. Several studies [10-12] indicated that females might tend to have significantly higher micronucleus frequency than males. Fenech and Bonassi [15] reports that a greater frequency of micronucleus among females exists compared with those among males. Like the results of the studies, both genders have equal chances of having micronuclei in their cells.

The result of our study has shown that elementary school children had higher chances of epithelial micronuclei occurrences compared with those in high school level. This finding may likely be attributed to the innate behavior of the elementary school children, as they are fond of exploring everything that they see around them. The behavior of children to explore things surrounding them makes them more susceptible to the possible sources of pollutants emanating in the environment. The particular behavior of these school children to their environment may also be likely to be responsible for the higher epithelial micronuclei occurrences [8]. Our interviews with the respondents corroborate our findings, as the high school students have indicated that they mostly use their handkerchiefs to protect themselves from the emissions and pollutants present in the environment especially as they traverse the streets from their homes to their schools and vice versa. The particular behavior of the high school students protecting themselves from emissions is supported by a study by Esan et al. (2004), where they indicated that children who belong to the higher education group tend to be more conscious of their health needs and tend to practice good hygiene because they have become well informed due to their increasing level of literacy. Despite the observed frequencies of micronuclei in the buccal exfoliated epithelial cells in the participants, no significant differences were evident. This study does not negate the possibility that these factors studied and the factors like lifestyle, diet, and genetic factors may contribute to the occurrence of epithelial micronuclei.

**Conclusions:**

Results of our study have shown a low prevalence of epithelial micronuclei occurrence in school children examined in both municipalities. Despite the observed frequencies of micronuclei in the buccal exfoliated epithelial cells, no significant differences in the results were observed. This does not negate the possibility that the factors may be attributable to the occurrences of epithelial micronuclei in the school children that participated in this study. Continuous monitoring and safeguarding the health and welfare of the school children is necessary to protect them and have a healthy well-being.
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REFERENCES


