

Is Play-Dough a Vector for Transporting and Accumulating Lead? A Pilot Study Of Daycares in Greater Vancouver

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Abstract

Background: The six daycares that participated in this study indicated that there is no regulation currently in place for the usage of play-dough in their daycare facilities. Play-dough can potentially accumulate and transport lead when played with. This vector has never been studied before in terms of being a route of lead exposure for children. This study aimed to determine whether or not play-dough usage in daycares may be a hazard in terms of being a route of lead exposure for children.

Methods: Daycares in the Greater Vancouver were randomly selected based on convenience sampling. They were contacted by email and a follow up phone call to determine their eligibility. Play-dough was gathered in three time intervals from each daycare and analyzed semi-quantitatively. Three controls were also created to mimic the daycare's play-dough usage, and to test whether the test kit could detect lead.

Results: The results showed that one of the daycares had lead levels ranging from 1-3ppm and one of the controls showed lead levels of 1-3ppm.

Discussion: The test kits proved to be effective in determining lead based on the controls. One of the daycare's play-dough had lead levels of 1-3ppm. Thus indicating that there is a possibility that play-dough can be a vector for transporting and accumulating lead. This study does have limitations in terms of the test kit used, and the lack of blinding of the researcher testing the samples.

Conclusion: The study was successful in generating an understanding of the potential link between play-dough usage and lead exposure for children. Therefore, the positive lead result found in one of the daycares can be used as a reference to guide future studies in this area.

Keywords: Daycare; Greater Vancouver; Lead; Play-Dough

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INTRODUCTION

Lead is commonly found hazardous metal that poses many health implications (1). High levels of lead exposure can be deadly, however low dose chronic exposure is also very hazardous, particularly to children (2). Studies have concluded that children who are exposed to lead at low levels have shown signs of cognitive impairment and lower IQ scores (3). These adverse health effects are thought to be irreversible (1).

Due to the impacts of low-level exposure, it is often argued that there is no safe level for lead exposure (1,2,4). Lead exposure can occur through different mechanisms, and the route of exposure which children are most often exposed to is hand-to-mouth behavior (1,2). Through placing items in their mouths, children can ingest household dust which lead has settled in (1). A study conducted by Ko, Schaefer, Vicario, and Binns concluded that there is a direct relationship between hand-to-mouth activities and blood lead levels (BLL) (5). Therefore, Ko et al's study showed that

increased hand-to-mouth activity was associated with higher BLL for children (5). Mouthing behavior is a normal activity for children, and regardless of gender it is very often done as a method of discovery (6).

Based on our research we have not found any studies that have looked at lead exposure through play-dough. Therefore, with the understanding of hand-to-mouth activity, and the fact that lead settles in dust, our study aimed to discover whether or not play-dough gathers lead, and if this is an area of concern in terms of lead exposure to children.

METHODS

Ethics

This study was approved by the University of British Columbia's Behavioral Research Ethics Board (ref no H16-01109). Informed consent was gained from daycare supervisors of each daycare.

For Gathering Participants

Through convenience sampling, we generated a list of twenty-one daycares in the greater Vancouver area. Contact

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Table 1. Results of the Controls

Usage Time	Negative Control 1 Result	Negative Control 2 Result	Negative Control 3 Result (Try 1)	Negative Control 3 Result (Try 2)
Zero	Not Tested	Not Tested	Not Tested	Not Tested
10 Minutes	Negative	Negative	Negative	Negative
30 Minutes	Negative	Negative	1-3 ppm	1-3 ppm

was made to the twenty-one daycares through email and a follow-up phone call. Thirteen out of the twenty-one daycares said they were interested and wanted to be part of the study.

Our eligibility criteria required usage of play-dough in daycares under normal conditions. This meant two things, firstly we did not ask daycares to change any behaviors in terms of using play-dough. Therefore, they had to already be using play-dough within their daycares. Secondly, they had to be using a batch of play-dough for at least a week in order for the daycares' time intervals to be consistent and directly comparable. From this, six daycares were eligible and included in the study. The daycares in this study were spread over the Lower Mainland, Greater Vancouver, and South Vancouver.

Questionnaire

Daycares that agreed to be part of the study also answered a brief questionnaire. They provided us information on the year their building was built, total number of registered children in daycare, where children play with the play-dough, how many children play with the play-dough and for how long, and lastly whether or not the site makes their own play-dough or buys commercial ones.

Test Kits

The ABOTEX Lead Inspector Test Kit was used for analyzing the samples for this study. We have no conflict of interest with this test kit, and it was chosen based on convenience. This test kit allows for samples to be tested semi-quantitatively.

Controls

Three controls were created in order to test the validity of the test kit and to provide a reference guide for analyzing samples. Two of these controls were negative controls that mimicked the daycare setting and involved playing with play-dough on a sanitized table for one of them and for the other, playing on sanitized table and intentionally dropping the play-dough (Table 1). A positive control was created to determine if the test kit was effective at detecting lead, and for this control the play-dough was purposely used on a polluted sidewalk near a busy road (Table 1). Reference Guide for Semi-quantitative test for Test kit retrieved from: <http://www.leadinspector.com> (Table 2).

RESULTS

The daycares in this study were all located in Greater Vancouver Area. They were intentionally selected to be spread out spatially to avoid any potential biases that could occur from environmental factors that we could not control. All the daycares created their own play-dough and were able to provide the three samples to be analyzed. All the daycares

Table 2. Semi-quantitative test for lead test kits

Colour	Parts per million (ppm)
Faint Yellowish Tint	1-3
Light Brown	5
Medium Brown	10
Dark Brown	25
Black	Over 50

said that play-dough was used regularly, and children played with it every day in the daycare setting. Currently there is no regulation on how play-dough should be made or used in these daycares.

Due to availability of the number of test kits, for Table 1, the first sample tested was the 10-minute sample, if results were negative, the "Zero" sample was not tested. The positive control was conducted twice to test reliability. For Table 3, the "After Three Days" samples were tested first. If the results were negative, "Before Use" samples were not tested, again due to number of test kits available. The samples for Daycare 3 were tested twice to test the reliability of the positive result (Table 3).

DISCUSSION

Results of the controls showed that control 1 and 2 were negative (Table 1). Control 3 showed lead in the 1-3 ppm range, confirming that the test kits can detect lead levels (Table 1). Regarding the samples, all but one daycare showed no detectable lead levels below the 1-3ppm range (Table 3). Daycare 3 showed lead in 1-3ppm after the third day of play and at the end of the week. Thus providing evidence that play-dough may gather lead when it is played with.

LIMITATIONS

This study had three major limitations. First, test kits start detecting lead at 1-3ppm. Therefore, any level below 1ppm is not detectable, and it does not distinguish between 1-3ppm. Secondly, test kits are based on a semi-quantitative analysis where the researcher judges the color change of the swab and matches it to the identification table in the package (Table 2). This may be prone to some error as a cloudy white result is considered negative, while a faint yellow is considered 1-3ppm. Additionally, the play-dough provided by the daycares had coloring added to them. The color added to the play-dough complicates the analysis when looking at the color change. Lastly, the researcher conducting the analysis was

Table 3. Results of the 6 Vancouver Daycares

Usage Time	Daycare 1 Result	Daycare 2 Result	Daycare 3 Result (Try 1)	Daycare 3 Result (Try 2)	Daycare 4 Result	Daycare 5 Result	Daycare 6 Result
Before Use	Not Tested	Not Tested	Negative	Not Tested	Not Tested	Not Tested	Negative
After 3 Days	Negative	Negative	1-3 ppm	1-3 ppm	Negative	Negative	Negative
End of the Week	Negative	Negative	1-3 ppm	1-3 ppm	Negative	Negative	Negative

not blinded to the samples, and it was the same person who collected the samples. The semi-quantitative test relied on this person to assess the results.

CONCLUSION

The major takeaway from this study, based on the daycares that participated, was the discovery that no regulation is in place in regards to where the play-dough in daycares can come from or how it should be made. Overall this pilot study accomplished its goal in starting to fill the research gap that exists in terms of understanding play-dough's role in accumulating and transporting lead. From our positive sample result, we concluded that there is a possibility that lead can be gathered in play-dough after repeated play, however more work is needed in order to fully confirm this result and implement necessary changes. Future studies should use quantitative testing of the play-dough samples, and should also test the utensils that children use when playing with play-dough. As we found that play-dough is seldom played with on its own; and that children use other toys simultaneously while playing with the play-dough. This was not something we could study and is a worthwhile consideration for future research.

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