A survey evaluation of disinfection knowledge comparison between licensed and unlicensed childcare facilities

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Abstract

Background
The concepts of children's environmental health are crucial for children's health and development. Between the ages of 2 to 5, children are developing their sensory and motor, cognitive, physical, immunological, emotional, social, and language skills. Many children spend long hours in day care facilities, and it is important to ensure a safe and healthy place for them. Environments with insufficient sanitation and hygiene could put children at risk and can also result in the spread of infectious diseases or even further impact their overall development. The purpose of this study was to investigate the disinfection knowledge and behaviour of childcare providers working in both License Required (LR) and License Not Required (LNR) daycare facilities in British Columbia.

Method
The study was conducted by a self-administered online survey. The data was collected via the online server, SurveyMonkey, and was analyzed through NCSS software (2021). A survey link was posted on the Facebook child care groups, and a cover letter with scannable QR code was delivered to child care facilities. The questionnaire was designed to assess child care provider's knowledge and behavior levels of disinfection.

Results
A total of 98 respondents were eligible in the study, and 82 completed the survey. Among 82 respondents, 82% (N=67) worked in licensed child care facilities, 16% (N=13) of them worked in licensed not required child care facilities, and 2% (N=2) of them preferred not to answer. Questions about disinfection and sanitation knowledge and behaviour resulted in scores that were categorized as High, Medium or Low. 51.3% of respondents overall received a Medium Knowledge Score, 31.3% a High knowledge score and 17.5% a Low knowledge score. Interestingly, those from Licence Required daycares were twice as likely to have a High knowledge score and half as likely (14.9% vs. 30.8%) to have a Low knowledge score. With respect to Behaviour, overall, 91% of respondents scored High, 7.5% Medium and 1.2% Low on disinfection Behaviour. Within the High Behaviour scores, there was a larger proportion of High scores, and a lower proportion of Medium scores among those working at License Required daycares compared to those working at License not required daycares. Although these descriptive results point to a possible association between knowledge and behaviour differences between those working at License required compared to License not required facilities, there were no statistically significant associations found between the behavior and knowledge of

disinfecting by child care providers and different types of childcare facilities (P=0.062 and P=0.243, respectively).

Conclusion
Although there were no statistically significant associations between knowledge and behavior of disinfecting in child care providers and different types of childcare facilities, from the descriptive data, patterns emerged suggesting that those working in License Required facilities may have more knowledge and better behaviours when in comes to disinfecting daycares. As daycares become more used by working parents, it is important that further research be done to better understand knowledge and behaviour of disinfection in daycare settings. Environmental Health Officers can play a vital role in infection control and disinfection education to those working in daycare facilities.

Keywords: Childcare, Licensed, Unlicensed, Disinfection, Sanitation, Knowledge, Behavior

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Introduction

Many children spend a major part of their day in childcare facilities. The children who spend hours in a child care facility have the same pattern as their parents' work hours. With the increasing of the working hours among parents, children also stay in child care for more hours. According to Statistics Canada, children aged 2 to 5 have the highest use of any form of child care (1). The concepts of children's environmental health are crucial for children's health and development. Children are more susceptible to certain environmental risks as they usually have a weaker immune system than adults due to their still developing body (2). In addition, putting children at risk would impact their overall development and even economic opportunities later in life; therefore, they need to be protected from environmental risks including air pollution, inadequate water, poor sanitation and hygiene, climate change, and radiation. Children may be exposed to environments with insufficient sanitation and hygiene, resulting in the spread of infectious disease. The most common childcare-associated infectious diseases are chickenpox, conjunctivitis, HFMD (Hand, Foot and Mouth Disease), and gastroenteritis. The spread of bacteria and viruses can be reduced by sanitizing high-touch surfaces within the childcare centers. However, routine sanitation practices conducted by childcare providers vary due to individual behaviors. The purpose of this review is to investigate the knowledge and behavior of childcare providers regarding disinfection.

Literature Review

The connection between childcare centers and diseases transmission

Epidemiological characteristics of contagious diseases can be applied to childcare centers. The population age group is 0 to 5 years old, which has the characteristic profiles and specific risks for the transmission of infectious diseases. Childcare centers provide a conducive environment for the pathogens to grow, and for the disease to occur (3). The characteristics of the infectious agent play a critical role to spread the disease in childcare facilities: the mode of microorganism transmission, infectivity of the population, prevention methods, and microorganism survival conditions. Inhalation, direct, and indirect transmission modes are more common in childcare settings (4).

Furthermore, young children attending childcare centers have a higher risk of developing respiratory infections, acute otitis media (AOM), diarrheal disease, invasive bacterial disease from Haemophilus influenzae and Streptococcus pneumoniae, hepatitis A, and infections by cytomegalovirus (CMV) and varicella-zoster virus (VZV) (5). Control measures are necessary to prevent young children from acquiring infections. For example, proper hand washing, employment of standard precautions, standardized routines for changing diapers, location and cleanliness of changing area, cleaning and disinfection of contaminated areas, separate workers and area for handling foods, notification of infectious diseases, training of workers and guidance for parents (3).

Effective disinfection of toys and equipment impact on transmission of infectious diseases

Pathogens can be transmitted either by direct contact or indirect contact. Ill children sneezing, coughing, or touching can infect other children. Doorknobs, table surfaces, and toys are playing the role of fomites for the transmission. Jang (6) found there was a high number of aerobic colonies on the surfaces of toys in general practitioners' offices, compared with the surface of receptionist' desks. Ibfelt et al (7) used swabs to determine if disinfection of toys can reduce the pathogen load and prevent children from getting sick. The result showed that microbial load dropped after cleaning and disinfection of toys. However, it does not seem to reduce sickness among preschoolers.

Knowledge on sanitizing different toy materials is limited. Hwang (8) investigated the hygiene practice on different materials of toys between large and family childcare facilities. The survey showed that there was no difference between the two types (group and family) of childcare providers in terms of their knowledge of sanitation of toys. Yip's (9) research study discovered that hygiene and communicable disease control inspection violations in child care facility in BC are rarely found. Additionally, Hwang's (8) survey showed that 95.6% had a sanitation plan (including disinfecting toys) in the setting, yet only 46.7% of respondents knew the correct sequence of sanitation procedures. Performing improper sanitization procedures can result in the rise of pathogens transmitted. Also, 22.2% of the survey respondents believed that natural products could disinfect toys effectively, and 24.4% answered unsure. As a result, a continuous education or a sanitization course is needed in Early Childhood Education.

Fowler (10) indicated that enteric diseases in schools and daycares commonly lead to outbreaks. The researcher assumed equipment in the playground was not frequently cleaned and could be a fomite to the pathogens. Yet, the result of swabs and plating did not find either Total Coliform count or E. coli. The researcher stated that indicator bacteria may be more likely present in other environmental sources, such as birds or other animals. Fowler suggested the need for hand sanitizing practices after using playground equipment and regularly cleaning it. Further research is needed to better understand the potential for infection among young children in a childcare or preschool situation.

Common pathogens associated with childcare facilities outbreaks

Most outbreaks in child care facilities are enteric and respiratory tract infections. Enteric infections are viral, bacterial, or parasitic infections. Respiratory tract infections are either bacterial or viral. The transmission routes of both infections are

almost the same. The transmission modes are person to person, fecal-oral contact, and improper hand hygiene and food preparation practices (11). Outbreaks in childcare facilities may be expected due to toileting and diapering (12). Ineffective cleaning and sanitation lead to the survival of pathogens and is a potential cause of an outbreak. The support of hygiene behaviors among children is needed. The hygiene practices of caregivers impact on the likelihood of children getting an illness. Ngure et al (13) conducted an observational study of hygiene behavior among children and caregivers. One-third (30%) of caregivers had visibly dirty hands before contact with young children as well as 17% of the children. The opportunities of possible contact with feces would increase if caregivers or children are not conducting proper hand washing. Children's daily exposure to fecal bacteria results from the mouthing of objects, frequent hand to mouth contact, and poor hand washing. Children are the population at risk of being vulnerable to gastrointestinal illness and would have severe outcomes (9). Educating caregivers on personal and environmental hygiene is necessary to provide young children a safe and clean environment (10).

Disease control and policies

The optimal strategy for controlling infectious diseases is prevention (4). Routine sanitization and disinfection are required in childcare settings. Siegel et al (14) conducted interviews with childcare providers and parents regarding specific perceptions of HFMD control measures. The researchers analyzed the data and concluded that child caregivers and parents need to have efficient communication for disease prevention. The childcare provider that was interviewed highlighted the stress of being responsible for preventing outbreaks. The parents are not always informing childcare providers of an HFMD diagnosis. Although there are policies about HFMD such as, an ill child must be isolated from other children, the prevention measures must be done with more details. For example, parents must understand the severity of HFMD and the procedures after a positive diagnosis of an illness. Employed parents need support with alternate care if the child needs to be isolated or the outbreak causes school closure. In addition, the prevention and control of infectious diseases among children in childcare facilities is a concern for childcare providers. The influence of risk factors can be introduced and disseminated to childcare facilities to both child caregivers and children with inappropriate personal hygiene, health status, and the condition of the facility such as the level of sanitation.

Vaccination is one of the disease control prevention methods. Childcare students before enrolling in the Early Childhood Education program must be vaccinated against Hepatitis B, MMR, Tetanus/ Diphtheria/ Pertussis (Tdap), and chicken pox. Influenza vaccine is needed yearly. A TB skin test is also mandatory. The mandatory vaccination policy in the childcare field has the potential to reduce vaccine preventable diseases within young children in childcare centers (15). Thus, immunization is important for preventing illness. Parents are responsible for making sure children have received all the immunizations recommended by Immunize BC (16).

Benefits of improving disinfection in childcare facilities

There is a close correlation between health and sanitation. According to WHO (2019), inadequate sanitation is associated with transmission of diseases. The outcome of poor sanitation results in reduced human

well-being, malnutrition, decreased social and economic development, and the loss of educational opportunities. There are 432,0000 diarrheal deaths annually (17), therefore, children are an at-risk population due the vulnerability to infectious diseases. Improving environment disinfecting and encouraging personal hygiene can reduce the spread of infectious diseases in childcare facilities. The benefit is not only in the caring settings, but also people surrounding childcare workers and parents who have been influenced by their children (18). Moreover, different disinfectants have different concentrations to effectively kill the pathogens. Bhatti (19) examined the use of vinegar as a sanitizer, the result showed undiluted vinegar was able to reduce Total Coliform counts, but it is not safe for human exposure. Environmental health inspectors must supervise childcare centers are using approved disinfectants and proper concentration which allow the efficient strength for the solutions. To educate the public with the use of disinfectants would help to reduce the risk of infectious disease transmission. It further provides advancement of environmental health in the childcare facility.

Gaps in research, knowledge, and policy

Child Care Licensing Regulation Section 46 subsection (1) requires the licensee to practice and ensure the facility follows the rules of health and hygiene (20). Health authorities provide guidelines that clearly indicate the protocols of how to deal with the outbreak and disinfect specific types of materials. However, neither guidelines nor legislation refers to the acceptable levels of contamination on environmental surfaces except food establishments (10). That is a problem that still needs to be investigated.

Childcare centers provide sickness policies, cleaning/sanitization policies, and hand hygiene and respiratory etiquette policies to childcare workers and parents. The documents are designed by the manager or the owner of the childcare facilities, but performance still needs to be observed, especially cleaning/sanitization policy.

There is no mention of the disinfection knowledge and behaviour between license required and licensed not required child care providers. Yet, the requirements of operating the two types of child care centers are varied with conditions. License required child care centers have a rigorous system that is monitored and inspected by the health authority. They must achieve a series of certain requirements; from center's space and equipment to staffing qualifications. Although license not required child care centers also have some specific requirements, it is not as challenging to accomplish. Registered licence not required child care must register with a Child Care Resource and Referral Centre (CCRR) and have 20 hours of child care-related training. For unregistered licence not required child care, there are no qualifications required. This type of child care provider may or may not have had an official training or experience in the child care field. Due to the different requirements of child care providers in both types of child care facilities, the study of disinfection knowledge and behavior is worthwhile in order to identify differences in knowledge and behaviour.

Strengths and limitations of the literature review

Through the articles identified from the literature review, it has been found that disinfection is important to prevent the occurrence of diseases. There were no findings with direct connections between outbreaks in childcare facilities and the sanitizing behavior of child care providers.

However, the evidence shows that insufficient sanitizing could cause infectious disease outbreaks. The knowledge and sanitizing behaviors of childcare providers should be investigated.

Literature review conclusion

Inadequate sanitation in the childcare facility provides the pathogens with potential growth conditions. Children have greater risk for acquiring infectious diseases and could have severe outcomes. A disease occurs when an external agent (pathogen), a susceptible host (child or childcare provider), and an environment (poor sanitation) brings the host and agent together. Vaccinations can prevent disease occurrence in children or childcare workers. Personal hygiene and the cleanliness of the environment can act as other ways of prevention. Disinfectants can eradicate pathogen growth in childcare facilities. Thus, a proper disinfection practice is critical to reduce microorganism load or even remove microorganism. Improper disinfection can be a trigger of an outbreak. Hence, Child Care Licensing Regulation requires childcare facilities to adhere to relevant legislation. A sickness policy, infection prevention plan, and exposure control measures must be planned and documented. Also, education provided in Early Childhood program does not include cleaning, sanitizing, disinfecting courses. The course of health, safety, and nutrition emphasizes common childhood illnesses and communicable diseases, preventative health measures, safety and supervision practices, nutritional needs of young children, and meal planning. Therefore, every Early Childhood Educator must obtain FoodSafe level 1 which contains cleaning and sanitizing learning.

The most common violations seen in childcare facilities include incorrect sanitizer and disinfectant concentration, non-functioning hot water at hand sinks, inappropriate staff and children illness policy, and incorrect procedures for washing toys (21). From this, sanitizing behavior among child care providers should be evaluated.

Methods and Materials

Standard Methods

The risk of infectious diseases transmission can be reduced by conducting disinfection correctly. A proper disinfection consists of three components: (i) the concentration of the disinfectants, (ii) contact time with the surface, and (iii) the procedures (22). The purpose of the study was to evaluate the knowledge of child care providers regarding the proper use of disinfectants between two different types of childcare facilities: Licensed and License not required. Only child care facilities in B.C. were selected. Licensed not required child care facilities were contacted through Child Care Resource and Referral Centres (CCRR) (26). A cover letter was sent to the CCRR regional Coordinator team via e-mail and then distributed to the 39 CCRR's in the B.C. Province. The lists of Licensed child care facilities addresses and email addresses were collected from health authorities in Metro Vancouver. To increase the number of responses, the researcher also delivered a cover letter with scannable QR code to child care facilities. The survey link was also posted on Facebook in the child care groups.

The questions were developed based on a resource book for caregivers and parents designed by Vancouver Coastal Health (23). This knowledge was assessed via a questionnaire administered to analyze the respondent's education, types of childcare facility working in, years of experience, types of disinfectants used, knowledge of the

ideal concentration of disinfectants, and behavior of sanitation procedure. A scored system was used in both the knowledge and behaviour section for evaluation. For the knowledge questionnaire section, more correct answers would get a higher final score. For the behavior questionnaire section, more frequently cleaned food contact surfaces would get a higher score number. The final score of behaviour questionnaire revealed a higher standard of cleanliness. Both knowledge and behavior sections were sorted into High, Medium, and Low scores.

The study population are comprised of individuals working in the child care facilities. The study participants completed the survey online server—SurveyMonkey. The survey was designed to be completed in approximately 5 minutes. The survey was open from January 19, 2022 to February 15, 2022.

Materials

The materials used for this study consisted of a computer accessible to internet, SurveyMonkey software (24), Number Cruncher Statistical System data analysis software (2021) (25), Microsoft Excel (Version 16.54), Facebook, a list of email address of Child Care Resource and Referral Centres (CCRR) offices in B.C. (26) , and lists of child care facilities collected from Fraser Health and Vancouver Coastal Health.

Inclusion and Exclusion

Inclusion and exclusion criteria must be specified in a study. Inclusion criteria establish the study population in a reliable manner (30). Moreover, inclusion criteria are the features that are eligible in the study. In contrast, exclusion criteria rule out the disqualified subjects (31). In this study, licensed child care included group and family child care, and preschool. License not required child care included registered and unregistered child care, and in-child's-own home care. All the participants must be child care providers in BC. The email addresses of licenced child care facilities were gathered from Fraser Health and Vancouver Coastal Health. Unlicensed child care facilities were contacted by CCRR due to confidentiality. The survey link was also posted to the Facebook groups in order to find child care providers who are working other than Metro Vancouver. Each type of the child care facility will have only one child care provider to respond to the survey. The years of the experience was not excluded due to the study's main aim which is to analyze the knowledge of the child care providers. Also, participants must provide full-time care in the child care field. Participants were informed about the eligibility of the study at the beginning of the questionnaire. The system automatically directed them to the end of the survey if they were not eligible: not a child care provider in BC and not providing full-time care.

Ethical Considerations

The electronic survey displayed a cover letter to introduce the study and a research consent form outlining the purpose, inclusion and exclusion criteria of the study, and confidentiality. Each participant must have read and clicked Agree to the consent form that was given to them before answering the survey questions. The survey was set up to automatically direct to the end of the survey if they responded Not Agree. The consent form was used to inform participants that the information gathered from the study would be kept confidential. The researcher's name and contact information was provided to the participants so that they could use it for the future to follow up. The participants had a chance to leave their email address at the last optional

question in the survey if they were interested in the results. The email addresess provided are kept confidential and only used for contact for the final report. All emails were deleted once the research project was completed. The survey was reviewed and approved by the British Columbia Institute of Technology (BCIT) Research Ethics Board (REB) to certify that the survey meets the requirements.

Statistical Analysis

Data Description

The data collected for this study were all non-numerical. The demographics section was dichotomous and multichotomous nominal data. The behaviour and knowledge of disinfection questions were collecting both nominal data (dichotomous and multichotomous) and ordinal data. The participants were given the option 'Prefer not to answer' or 'I don't know'. They could also simply skip the question if they were not willing to answer. This research study uses pie charts and bar graph to present dichotomous and multichotomous nominal data.

Statistical Package Used

Data was downloaded from SurveyMonkey server. The raw data were inputted to MS Excel once the survey closed. NCSS data analysis software (2021) (25) analyzed the raw data from MS Excel. Pearson's Chi-Square Test was chosen for the inferential statistics test to conduct nominal data analysis. The statistical package was used for investigating if there was /not a statistically significant association between sanitation knowledge in child care providers and types of child care facilities

Results

By the end of the survey period, a total of 107 participants responded. Of those who responded, 98 of them were eligible, and 82 completed the survey. However, only 80 of the responses were used to NCSS to analyze the data. 2 of the respondents were taken out of the data due to not indicating the types of child care facilities that they are working at.

Descriptive Statistics

All descriptive statistical data were collected from the demographic section of the survey. Out of the total of 80 individuals who participated in this research study, 82% (N=67) worked in licensed child care facilities, 16% (N=13) of them worked in licensed not required child care facilities (Figure 1).

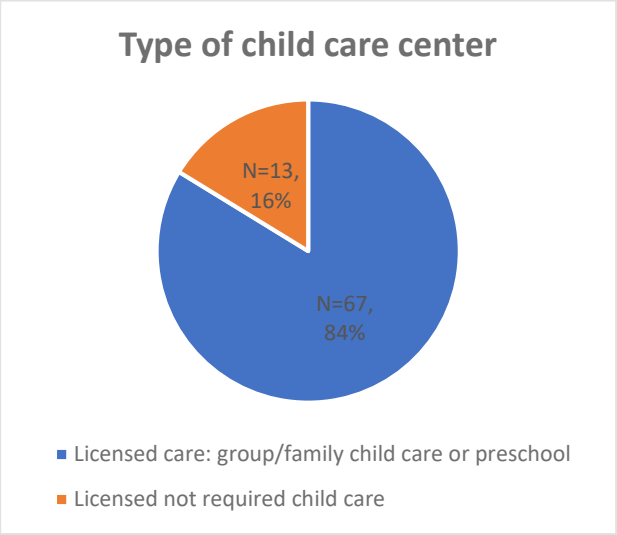

Figure 1. Type of child care facilities of respondents work in

100% (N=80) of the respondents identified themselves as female. Employees in licensed based child care centers are more likely to have Early Childhood Education qualifications (32). The main qualification in licensed child care facility was Early Childhood Educator (N=46). Responsible adult was the majority of the qualification in unlicensed child care facility (N=7) (Figure 2).

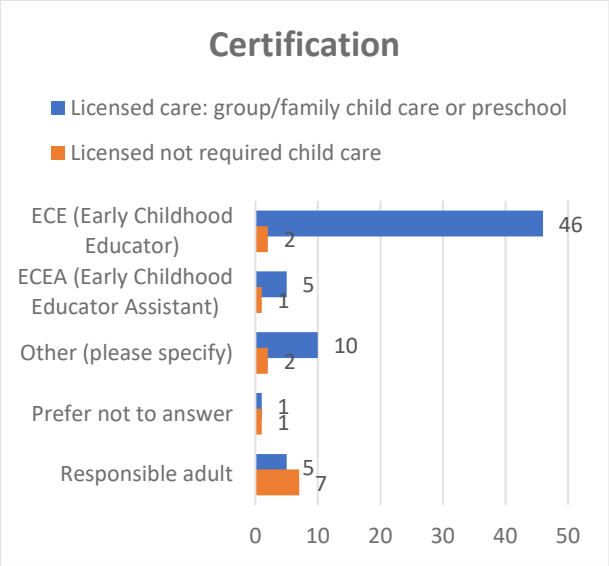

Figure 2. Type of child care provider's certification

The majority of licensed child care providers held a diploma or associate degree (N=38) followed by Bachelor's degree or higher (N=17). The majority of licensed not required child care providers also held a diploma or associate degree (N=4) followed by specialization certificate and high school or less (both were N=3) (Figure 3).

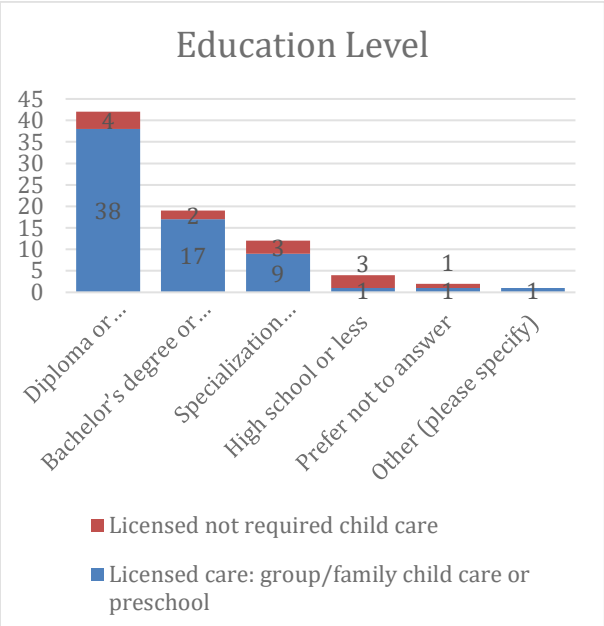

Figure 3. Education level

Most of the respondents who were working in licensed child care, have 15 or more years of experience (N=27, or 40%) whereas licensed not required child care has 15 or more and 0-4 year of experience as the major population (both N=4, or 31%) (Figure 4).

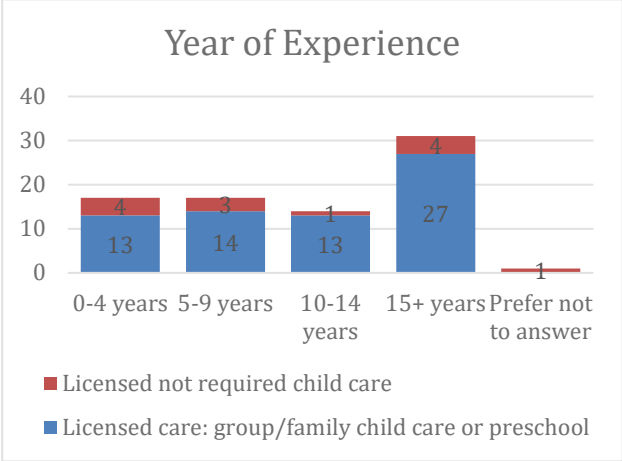

Figure 4. Year of Experience

In regards to the types of disinfectant, chlorine was the most popular to use, followed by alcohol and natural product (Figure 5). Respondents who chose 'other', indicated that the specific name of disinfectants. Most of them were Lysol.

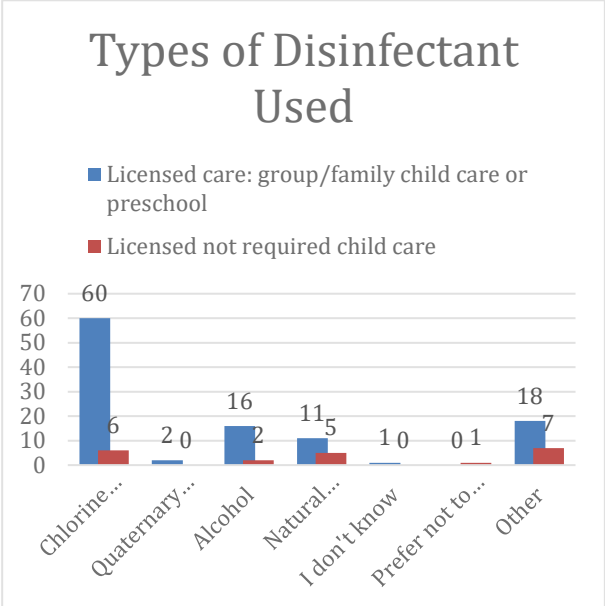

Figure 5. Type of Disinfectants Used

	High (N and %)	Medium (N and %)	Low (N and %)	Total N
License required	23 (34.3%)	34 (50.7%)	10 (14.9%)	67
License not required	2 (15.4%)	7 (53.8%)	4 (30.8%)	13
Total	25 (31.3%)	41 (51.3%)	14 (17.5%)	80

Table 1. Score of Knowledge

	High (N and %)	Medium (N and %)	Low (N and %)	Total N
License required	63 (94%)	3 (4.5%)	1 (1.5%)	67
License not required	10 (77%)	3 (23%)	0 (0%)	13
Total	73 (91.3%)	6 (7.5%)	1 (1.25%)	80

Table 2. Score of Behavior

The Score of Knowledge (Table 1) clearly shows that high knowledge occurs more frequently in License required facilities (34.3%) compared to License not Required facilities (15.4%), and Low knowledge occurs twice as often in License not Required (30.8%) compared to Licence required day cares (14.9%). Overall, more respondents got a medium knowledge score (51.3%) than a high or low knowledge score (31.3% overall for high knowledge and 17.5% for low knowledge).

For Score of Behaviour (Table 2), 91% of the whole study group scored high in their disinfectant behaviour, but those in license required daycares had a higher % of high scores (94%) compared to those working in license not required centres (77%), Also those working in license not required had a higher % of medium behaviour scores (23% vs. 4.5%).

Inferential statistics

Each answer to behaviour and knowledge survey questions was scored with a numerical value. The score ranking was divided into three levels which was high, medium, and low. For example, respondents who got 2 to 3 correct answers in knowledge questions, would get a High total score. Respondents got 1 correct answer would be recognized as Medium score, and 0 as Low score. The same scoring system was used for behavior questions.

The NCSS data analysis software (2021) (25) was used to analyze the data. Pearson's Chi-Square test was used to perform two categories' variables (33), the comparison of child care providers behaviors and knowledge with using disinfectants between licensed and unlicensed child care facility. The first test was to analyze the behavior in child care providers and different types of childcare facilities. The p-value from Pearson's Chi-Square was 0.062; therefore, do not reject Ho. The second test was to analyze the knowledge in child care providers and different types of childcare facilities. The p-value from Pearson's Chi-Square was 0.243; therefore, do not reject Ho. From the results of both tests, p-values were greater than cut off 0.05 and have possible beta errors. The hypotheses and results for this study are shown in Table 3. Childcare providers who are working at licensed and unlicensed childcare facilities have the same behavior regarding disinfection practices and the same knowledge regarding effective concentration of disinfectants for killing pathogens.

Table 3 Hypotheses and results

H_0 and H_a	Test used	Result	Conclusion
H_0: There is no association between behaviour in child care providers and different types of childcare facilities H_a: There is an association between behaviour in child care providers and different types of childcare facilities	Pearson's Chi-Square test	P-values = 0.062	Do not reject null hypothesis and conclude that there is no statistically significant association between the behavior of disinfecting in child care providers and different types of childcare facilities. Potential beta error. Increasing sample size would minimize the error.
H_0: There is no association between knowledge in child care providers and different types of childcare facilities H_a: There is an association between knowledge in child care providers and different types of childcare facilities	Pearson's Chi-Square test	P-values = 0.243	Do not reject null hypothesis and conclude that there is no statistically significant association between the knowledge of effective concentration of disinfectants and types of childcare facility.

Discussion

The purpose of this study was to determine the knowledge and behavior of childcare providers regarding disinfection in different types of child care facilities. The result was both hypotheses were not rejected. There is no statistically significant association between the knowledge and behavior of disinfecting in child care providers and different types of childcare facilities. Although inferential statistics did not have statistically significant results, descriptive statistics suggest that more disinfection education overall may be beneficial. License not required may need even more education as their knowledge score level was lower than those working at licence required facilities. Thus, the behaviour overall is very good, but it does not mirror the knowledge. For example, 77% of Licenced not required respondents received High behavior scores but only 15.4% scored High on knowledge. From the descriptive data, one can conclude that child care providers working at licence required facilities have higher knowledge than those in licence not required facilities. However, education of disinfection knowledge is needed in both types of child care facilities.

The main concern of this study was the group size of license not required child care

facility. To increase the sample size to reduce beta errors, two groups of the respondents were combined. The respondents who answered 'Prefer not to answer' to the type of child care facility question were included in the group of licensed not required. This consideration was based on assuming child care providers who are working at licenced not required might not have the intent to express their workplace. There are two main types of licensed not required (LNR) child care facilities, registered and unregistered. For registered license not required (R-LNR) child care, they must have registered with Child Care Resource and Referral Centre (CCRR). The operators must achieve the certain requirement and are regulated under CCRR. For unregistered-LNR child care, they are not monitored or inspected, neither do they have to meet health or safety standards. There are no specific qualifications required for the child care providers.

The researcher also assumed that babysitters and nannies does not understand that they are in the group of licenced not required due to most of them being self-employed. However, the results of combining licensed not required and prefer not to answer were the same as without combining—there is no significant association in child care providers behavior and knowledge between different types of childcare facility. Therefore, considering the scientific rigour of the result and eliminating the biases, the researcher took away two of the respondents who answered 'Prefer not to answer'. Hence, the beta error is not reduced while combining the groups.

This study has found a lack of statistical association in both disinfection Knowledge and Behaviour for child care providers in both licensed required and licensed not required child care facilities. However, the descriptive study result shows that child care givers in license required centers are more knowledgeable with the disinfection compared to caregivers in license not required centers. From this, the promotion of disinfection knowledge in child care field is required to further change the behavior regarding disinfection. To be more knowledgeable in the area of disinfection impacts on the understanding and willingness of performing sanitation. Further benefits include reducing the spread of communicable diseases and enhancement of children development environment.

Limitations

In person interviews or any type of observational study would be challenging and unadvisable during the COVID-19 Pandemic. As such, this survey was conducted online. Results were highly dependent on respondent's honesty in answering the questions. Using email to distribute the survey was also a limitation due to the possibility of it being send to junk mailboxes, or just ignored. The posts on the Facebook were limited because of groups rules. Some of the Facebook groups did not allow the survey to be posted.

The main limitation was the lack of respondents who are working in either registered or unregistered LNRs. For unregistered LNRs, since most of them were self-employed, there was limited contact information so it was difficult to reach out. Some are working as part-time in the field which makes them ineligible for the study. For registered LNRs, CCRR was not able to provide R-LNR's information due to confidentiality but was able help with forwarding the invitation email.

A lack of time resulted in a lack of LNR respondents. It was the week before the end

of the study period when the decision was made to reached out to CCRR. R-LNR workers were unable to have enough time to conduct the survey because of the time limitation.

Knowledge Translation

The results from this study can be further applied to health education and promotion for child care providers. Results highlight the importance of educating child care providers with disinfection and disease control prevention education. It can be adopted to Early Childhood Educators professional development workshops as a requirement. ECEs are required to meet a minimum of 40 professional development hours of their certification term. Continuing training would make the disinfection practice more accurate. Equally, licensed not required facilities must have more strict requirements for the caregivers. Advanced studies would be beneficial for this group of workers.

Future Study

Future studies recommended include:

- Surveying parents who have children aged 3-5 years old about behavior regarding disinfection at home.
- As this study discovered that there are many different disinfectants used in the child care facilities, an investigation of disinfectants used for food and non-food contact surfaces in child care facilities would be interesting.

Conclusions

Children's development affects their future life. The early years are the most susceptible to infection but also an important developmental stage. Other than home, children may spend several hours in a child care facility every day. To provide a safe and healthy environment, good practice and knowledge of disinfection is necessary. Although this study could not find a statistically significant association between knowledge and behavior of disinfection in different types of childcare facilities, descriptive results suggest a deficit in disinfection knowledge exists. As such, a continuous education course regarding disinfections and disease control prevention would be helpful for child care providers. The importance of the awareness of hygiene in the child care facilities will help to keep children away from the environmental risks.

Acknowledgements

The lead author would like to acknowledge the supervisor of this project, Helen Heacock, for providing support and guidance throughout the duration of this project.

Competing Interest

The authors declare that they have no competing interests.

References

1. Sinha M. Young Canadians providing care. Statistics Canada [Internet]. 2014 Oct 30 [cited 2022 Apr 20]; Available from https://www150.statcan.gc.ca/n1/pub/89-652-x/89-652-x2014003-eng.pdf
2. Children's environmental health [Internet]. World Health Organization. [cited 2021 Nov 15]. Available from: https://www.who.int/health-topics/children-environmental-health#tab=tab_1
3. Mastrobuono Nesti MM, Goldbaum M. Infectious diseases and daycare and preschool education. Vol. 83, Jornal de Pediatria. 2007. p. 299–312.
4. Mink Anna M. Chris, Yeh Sylvia. Infections in Child-care Facilities and School. [cited 2021 Nov 15]; Available from: https://publications.aap.org/pediatricsinrevie

w/article-abstract/30/7/259/33253/Infections-in-Child-care-Facilities-and-Schools?redirectedFrom=fulltext
5. Shane, A. L., & Pickering, L. K. (2012). Infections Associated with Group Childcare. Principles and Practice of Pediatric Infectious Diseases, 24–32.e6. https://doi.org/10.1016/B978-1-4377-2702-9.00102-1
6. Jang Kira, Heacock Helen. An evaluation of infection control measures on hard toys in general practitioners' offices in Vancouver, BC, Canada using microbiological sampling. BCIT Environmental Health Research Project. 2010 May 3.
7. Ibfelt T, Engelund EH, Schultz AC, Andersen LP. Effect of cleaning and disinfection of toys on infectious diseases and micro-organisms in daycare nurseries. Journal of Hospital Infection. 2015 Feb 1;89(2):109–15.
8. Ha Y, Hwang S. Knowledge Comparison Between Group Childcare Centres and Family Childcares on Sanitation of Toys [Internet]. 2017 [cited 2021 Nov 15]. Available from: https://journals.bcit.ca/index.php/ehj/article/view/83/69
9. Yip T, Heacock H, Sidhu B, Mcintyre L, Leader B. Inspection Violations and Community Care Facilities in British Columbia, Canada [Internet]. [cited 2021 Nov 15]. Available from: https://journals.bcit.ca/index.php/ehj/article/view/125/110
10. Fowler D, Karakilic V. Sampling of Elementary School Playground Equipment for Total Coliforms and E. coli. [Internet]. [cited 2021 Nov 15]. Available from: https://journals.bcit.ca/index.php/ehj/article/view/110/96
11. Collins, J. P., & Shane, A. L. (2018). Infections Associated with Group Childcare. Principles and Practice of Pediatric Infectious Diseases, 25–32.e3. https://doi.org/10.1016/B978-0-323-40181-4.00003-7
12. Communicable Disease Control Management of Gastrointestinal Illness Outbreaks in Child Care Facilities [Internet]. BC Centre for Disease Control. 2011 [cited 2021 Nov 15]. Available from: http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Epid/CD%20Manual/Chapter%201%20-%20CDC/CCFOutbreakguidelines.pdf
13. Ngure FM, Humphrey JH, Mbuya MNN, Majo F, Mutasa K, Govha M, et al. Formative research on hygiene behaviors and geophagy among infants and young children and implications of exposure to fecal bacteria. American Journal of Tropical Medicine and Hygiene. 2013 Oct;89(4):709–16.
14. Siegel K, Cook AR, La H. The impact of hand, foot and mouth disease control policies in Singapore: A qualitative analysis of public perceptions. Vol. 38, Journal of Public Health Policy. Palgrave Macmillan Ltd.; 2017. p. 271–87.
15. Rebmann T, Wang J, Wilson KD, Gilbertson PG, Wakefield M. Parents' and staff's support for a childcare agency employee mandatory vaccination policy or agency certification program. American Journal of Infection Control. 2016 Jul 1;44(7):799–804.
16. Vaccine schedules [Internet]. ImmunizeBC. 2020 [cited 2021 Nov 15]. Available from: https://immunizebc.ca/vaccine-schedules
17. Sanitation [Internet]. World Health Organization. 2019 [cited 2021 Nov 15]. Available from: https://www.who.int/news-room/fact-sheets/detail/sanitation
18. Staniford LJ, Schmidtke KA. A systematic review of hand-hygiene and environmental-disinfection interventions in settings with children. Vol. 20, BMC Public Health. BioMed Central Ltd.; 2020.

19. Bhatti G, Heacock H. Evaluating the Effectiveness of Vinegar as a Sanitizer. BCIT Environmental Public Health Journal [internet]. 2016 [cited 2022 Apr 20]; Available from: https://circuit.bcit.ca/repository/islandora/object/repository%3A327?solr_nav%5Bid%5D=e195b60de04c90e6b338&solr_nav%5Bpage%5D=0&solr_nav%5Boffset%5D=0
20. Community Care and Assisted Living Act Child Care Licensing Regulation [Internet]. 2007. Available from: www.bclaws.ca.
21. Colorado Department of Public Health and Environment. Child Care Health and Sanitation Rules and Regulations [Internet]. [cited 2021 Nov 15]. Available from: https://www.weldchildcare.com/files/sharedassets/public/departments/health-and-environment/documents/child-care-health-and-sanitation-rules-editing.pdf
22. Cleaning & Disinfecting School [Internet]. Centers for Disease Control and Prevention. 2021 [cited 2021 Nov 15]. Available from: https://www.cdc.gov/flu/school/cleaning.htm?web=1&wdLOR=c4842FBB3-313A-374D-B414-D774C751145F
23. Vancouver Coastal Health. DISEASES SNEEZES A Resource Book for Caregivers & Parents [Internet]. 2019 [cited 2021 Dec 11]. Available from: https://sneezesdiseases.com/assets/uploads/1589214601pDsukixOst24Mk9wayE3eA9Jjji7.pdf
24. SurveyMonkey [Internet]. [cited 2021 Nov 15]. Available from: https://www.surveymonkey.com
25. Number Cruncher Statistical Systems (NCSS) data analysis 2021 [Internet]. 2011 [cited 2021 Nov 15]. Available from: https://www.ncss.com
26. Child Care Resource and Referral Centres [Internet]. Government of British Columbia. [cited 2021 Nov 15]. Available from: https://www2.gov.bc.ca/gov/content/family-social-supports/caring-for-young-children/how-to-access-child-care/child-care-resource-referral-centre
27. Wright B.Kevin. Researching Internet-Based Populations: Advantages and Disadvantages of Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey Services. Computer-Mediated Communication [Internet]. 2005 Apr [cited 2021 Nov 15];103(3,1). Available from: https://academic.oup.com/jcmc/article/10/3/JCMC1034/4614509
28. Mohajan HK. Two criteria for good measurements in research: Validity and reliability. Annals of Spiru Haret University. Economic Series. 2017;17(4):59-82.
29. Kimberlin CL, Winterstein AG. Validity and reliability of measurement instruments used in research. Vol. 65, American Journal of Health-System Pharmacy. American Society of Health-Systems Pharmacy; 2008. p. 2276–84.
30. Garg R. Methodology for research I. Vol. 60, Indian Journal of Anaesthesia. Indian Society of Anaesthetists; 2016. p. 640–5.
31. Patino CM, Ferreira JC. Inclusion and exclusion criteria in research studies: Definitions and why they matter. Vol. 44, Jornal Brasileiro de Pneumologia. Sociedade Brasileira de Pneumologia e Tisiologia; 2018. p. 84.
32. Canadian Survey on the Provision of Child Care Services [Internet]. 2021 [cited 2021 Nov 15]. Available from: https://www150.statcan.gc.ca/n1/daily-quotidien/210615/dq210615c-eng.htm
33. McHugh ML. The Chi-square test of independence. Biochemia Medica. 2012 Jun;23(2):143–9.