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Child Hand Washing Intervention (Age < 5 Years) Against The Risk of Infection in Child Care: Systematic Review

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ABSTRACT
The risk of infection experienced by children (age < 5 years) who do not wash their hands properly becomes a serious threat to the health of the child. The study aims to explain handwashing interventions in child care facilities against the risk of infection.
A systematic review was obtained from five electronic databases (Scopus, PubMed, Science Direct, SAGE and ProQuest), published between 2010-2020. The study design; Narrative analysis of the study's findings also has been conducted.
A total of 25 studies that met inclusion criteria in the review. The study covered two broad thematic areas on comprehensive handwashing interventions (n=18) and those focused on behavior (n=7). The average number of participants was more than one hundred respondents. Dealing with hand washing is essential in first aid to prevent the risk of infection in children aged < 5 years. Various interventions can have a significant effect on reducing the risk of infection although other interventions provide different successes.

Keywords: Children (Age<5 Years), Child Care, Hand Washing, Infection Risk

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BACKGROUND

Infectious diseases are one of the causes of high mortality and morbidity in children less than 5 years of age worldwide. This age has a high risk of infectious diseases, especially for children attending child care facilities (Biezen et al., 2019). Most children as young < 5 are enrolled in a childcare centre and spend an average of 35 hours per week in the area (Fraser et al., 2015). Children attending day care facilities experience more disease infections than home-treated children (Van Beeck et al., 2016). So far, the form of hand washing intervention as a first prevention aid at the risk of infection such as hand washing with singing methods, playing pictures and demonstrations using video in children has been widely applied in child care facilities. However, to date there has been no comprehensive summary of the comparison of effective interventions with each other.

Over the past few decades, children in day care facilities have contributed to an increased risk of respiratory and gastrointestinal infections (Gudnason et al., 2013). Children attending day care centers (DCC) have a prevalence of respiratory infections (Respiration Infections) between 6.5 and 10.4 annually (Azor-Martinez et al., 2020a). This respiratory infection is 2-3 times greater in children treated in day care facilities than those who are only cared for at home (Clark et al., 2016). Data on cases of other respiratory infectious diseases in children aged < 5 years such as pneumonia has killed about 800,000 children in the space of a year (Unicef, 2020). In different parts of the world, the incidence of children dying of pneumonia occurs every 39 seconds (McGuinness et al., 2018). In addition infectious diseases *Tuberculosis* is a disease in which most deaths occur among children under the age of 5 (Unicef, 2020).

Children in daycare facilities experienced 2.3-3.5 times more gastrointestinal infections or gastrointestinal infections than children treated in their own homes (Fraser et al., 2015). After that, children as young as < 5 years old are very susceptible to rotavirus and diarrheal diseases commonly transmitted in child care. In recent years, significant progress has been made to reduce cases of child deaths from diarrhea. In 2017 diarrheal disease has killed about 480,000 young children worldwide, accounting for 8 percent of all deaths among children under the age of 5 (Unicef, 2020). The correct and appropriate action of hand washing procedures of international standards is essential applied to remove the causative organisms responsible for the spread of infectious diseases (Clark et al., 2016).

Child care centers can be a very conducive place for the spread of disease germs, both viruses, bacteria and other microorganism causes infction in children. Many children come together from different environments, this can make a person a contaminant agent that can then infect some other residents (ECDC, 2013). In day care centers, transmission of infectious diseases is facilitated by the immature immune system of the child, the presence of limited space for a large number of children, intense contact between children and caregivers, as well as low adherence to hand hygiene practices (Mendes et al., 2020; Van Beeck et al., 2016; T. P. Zomer et al., 2015). Different behaviors of children according to their growth can increase the risk of cross contamination between individuals and each other. In addition, transmission from one child to another through contaminated hands and objects plays a key role in the spread of infection in child care facilities (Health et al., 2011).

Infectious disease-causing microorganisms such as bacteria, viruses and parasites are on the hands and live on the surface of the skin naturally. The use of soaps or detergents and water and alcohol can eliminate most of these organisms and reduce the risk of cross-infection (To & Hands, 2011). Educating and encouraging children to wash their hands properly can effectively help reduce the incidence of infectious diseases (Service, 2018). The act of washing hands is an important strategy in the prevention of the spread of many

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infectious diseases in children. Infections in child care facilities can be spread through direct physical contact between people in the neighborhood, airborne droplets from coughing and sneezing or from contact with dirty surfaces and objects (ECDC, 2013). Children come into contact with others, both with children and adults, toys, cutlery and utensils, this creates a higher risk of exposure to infections and spreading infectious diseases. Prevention of infectious diseases in children can be done by helping children to develop the habit of washing hands early in child care facilities, because it will be embedded as they grow and develop (Service, 2018).

Handwashing interventions in children that include training and monitoring of hand washing periodically as a prevention against the risk of infection are important to be considered by health providers in child care facilities. Hands washing training without further monitoring or supervision often fails in establishing consistency of handwashing behavior in children, so that the decrease in infection spread is also not achieved (Pincock et al., 2012). A good handwashing intervention in children, will ensure all respondents involved are properly trained in accordance with the guidelines of hand washing standards set by the World Health Organisation relating to when is the right time to wash hands and how to wash hands properly (To & Hands, 2011). In addition, creative handwashing interventions tailored to children's development can make children see the importance of hand washing as well as the effects of each step of hand washing (Pittet, 2009).

Several handwashing interventions have been developed to reduce infections in children in child care facilities, but they show varying success rates (Tizza P. Zomer et al., 2013). A study of hygiene interventions at day care centers or daycare facilities aimed at reducing rates of respiratory and gastrointestinal infections in children has been published. Hand hygiene is known as an effective step to prevent gastrointestinal respiratory infections among children and caregivers in early childhood education services (Willmott et al., 2016). Based on the description above, a comprehensive summary of handwashing interventions that have been implemented in addressing the risk of infection in children less than 5 years old who are in child care facilities, so that the most effective interventions can be applied in the settings of child care facilities widely.

METHODS

Article identification is done through searches on 5 databases: Scopus, PubMed, Science Direct, SAGE and ProQuest published between (2010-2020). Keywords in systematic review is adapted to Medical Subject Heading (MeSH) and consists of various combinations of terms such as " Hand hygiene ", " Infectious illness ", "Child day care center", "Child (age < 5 years)", and "Intervention". We found 25 articles that fit our inclusion criteria, namely studies focusing on child care facilities affected by infection risk, studies that examined handwashing interventions given to respondents, both individual and group interventions, studies explaining handwashing interventions have an effect on the prevention of infection risk in children aged < 5 years in child care facilities. All articles are in English. We exclude articles if studies that do not review the risk of infection in child care facilities.

RESULTS

Twenty-five existing journals were descriptively analyzed. Research conducted by Lidal *et al* (2015) evaluated the effects of infection control interventions, then classified the study into two main categories, namely simple interventions and complex interventions. The main findings in this simple infection control intervention are attention to hand hygiene

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compared to standard practices reducing the incidence of diarrhea to hazard ratio (CI 0.31 to 0.61), respiratory tract infections (CI 0.57 to 0.83) and also reducing absenteeism (CI 0.80 to 0.96) among children. The use of alcohol-based hand gels every 60 minutes versus before lunch or just every 120 minutes can reduce the incidence of diseases such as influenza (p = 0.002 and p=0.008) (I.B. Lidal et al., 2015). Zomer *et al* (2016) conducted a study with the aim of researching the effects of complex interventions aimed at preventing and reducing infections. This intervention combines hand washing and training. The main findings in the combined intervention are systematic and continuous hand washing practices, cleanliness in toys and the environment performed in a regular manner compared to the results of standard practices. Other results obtained were reduced incidence of common disease episodes (CI 0.84 to 0.96), diarrhea (CI 0.50 to 0.90), respiratory infections (CI 0.77 to 0.90 0.94), lower number of physician consultations (CI 0.74 to 0.87) and fewer antibiotics prescribed to children (CI 0.73 to 0.78).

Interventions that combine the practice of hand washing, the provision of liquid soap and paper towels, cup racks with individual cups, as well as training (staff and children) resulted in little or no change in absenteeism compared to controls (CI 0.81 to 1.32). Education-based interventions combined with the results of handwashing practices have little or no effect on absenteeism rates (CI 0.78-1.05). Other studies have shown that attention to hand hygiene has a significant effect on the incidence of diarrhea and respiratory infections (T. P. Zomer et al., 2016).

Meanwhile, another study conducted by Lidal *et al* (2014) on the evaluation of the effects of interventions on secondary diseases, the use or resistance to antibiotics, adverse events of intervention, cost or use of health services showed the best documentation on complex interventions, namely interventions consisting of a combination of initiatives to reduce the spread of infection. Its main finding was to significantly reduce the incidence of respiratory infections and diarrhea by 50% compared to control. Such interventions also improve hygiene (compliance) behavior among children. Complex interventions combining hand disinfection, handwashing, and handwashing education reduced absenteeism due to infection by 30-50% in children compared to the control group who only performed hand washing as usual or hand rubbing using a placebo. Documentation of simple interventions by alcohol-based hand rubbing or hand washing in schools, has major methodological drawbacks. This does not mean that such interventions are ineffective, but it does mean that the basic evidence is too weak to deduce its possible effects (Ingeborg Beate Lidal et al., 2014).

Summarizing the comparison of research data conducted by Annesi (2011) collected from preintervention in parents since eight weeks after intervention obtained results that parents reported that eight weeks post-intervention most children (73%) consistently wash their hands, and about 60% report that their child consistently rubs his hands together for at least ten seconds. All parents reported that their child washed their hands without encouragement from parents, mostly children (57%) wash their hands after using the restroom at home without encouragement from adults whereas previously parents also reported that most children (83%) do not consistently rub their hands together for at least 10 seconds while washing. Most children (83%) need advice to wash your hands before eating for some time. Only 27% of parents reported that their child washed his hands consistently without asking after using the restroom. The frequency of hand washing in children aged five years showed significantly increased results (p = .000) after attending the handwashing education program (Annesi, 2011).

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Research conducted by Martinez *et al* (2020) aims to assess the effectiveness of handwashing education programs in day care centers and homes against the incidence of acute gastroenteritis. A total of 911 children aged 0-3 at 24 Almería (Spain) daycare centres were respondents in the study. The results showed that the largest reduction in acute episodes of gastroenteritis occurred in children who participated in hand washing programs using hand sanitizer (Azor-Martinez et al., 2020b).

Furthermore, research on other cases of infection is a study conducted by Ban Hai Qun *et al* (2015) in China. A total of 408 children under 5 years old were recruited and randomly grouped into intervention and control groups. This study aims to assess the effectiveness of several handwashing and disinfection interventions. Diseases and symptoms that occur in children are recorded daily. A total of 393 children have completed this study. The results obtained in this study are symptoms (fever, cough and expect, colds and nasal congestion, diarrhea), diseases (acute respiratory diseases and digestive diseases), and pain and absence per person each month is significantly reduced, except for abdominal pain, fever rates, diarrhea, acute respiratory diseases, digestive diseases and sick leave per person per year significantly decreased (Ban et al., 2015).

Other studies assessing the effectiveness of hand washing, surface disinfection and other hygiene interventions in preventing or reducing the spread of diseases from respiratory viruses were also conducted by Al Ansary *et al* (2020). Results from its systematic review showed a relative decrease of about 16% in the number of participants with acute respiration infections (0.82 to 0.86) in the intervention group, and in influenza cases (0.61 to 1.34). Three trials were measured on absence, and found about a relative 36% reduction in the number of absenteeism in the handwashing group (0.58 to 0.71) (Al-Ansary et al., 2020). Further studies with randomized controlled trials by Mendes *et al* (2020) conducted at 711 day care centers in the Netherlands investigated the effectiveness of intervention programs on hand washing. Opportunities for hand washing among children and caregivers are analyzed and the effect of this intervention is that the child feels happy and compliance with hand washing increases (Mendes et al., 2020).

Research at other day care centers in 115 North Carolina and 393 South Carolina, found 18 child care facilities in North Carolina and 22 South Carolina day care facilities agreed to participate. This study used questionnaires in the following sections, namely training, facility policy, facility characteristics, and employee and child health and obtained significant results (Li et al., 2014). The summary of the findings of two childcare-based studies provides low quality at the reduction of the incidence of acute respiration infection, as the largest risk-reducing handwashing interventions were seen in trials that also used hand sanitizer and antibacterial products for its application (McGuinness et al., 2018).

Several handwashing interventions have been developed to reduce infections in childcare facilities. In the national handwashing guidelines in the Netherlands outlined hand washing guidelines to reduce infection among children attending childcare facilities. The four components of joint intervention have the potential for better handwashing compliance and fewer cases of gastrointestinal infections and respiratory infections among children attending child care facilities (T. P. Zomer et al., 2015). The ratio of incidence rates adjusted to disease in child care facilities, both interventions and non-interventions are not significantly different for any of the diseases and there are no significant effects seen related to time (Gudnason et al., 2013). Hand washing compliance is an effective way to limit childhood illnesses, but results remain low among personnel at early childhood centers.

The study conducted by Clark *et al* (2016) determined the compliance of hand washing and the efficacy of respondents in child care facilities. The method used in this study is to

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use surveillance cameras to determine the chances of hand washing, compliance, appearance, and effectiveness based on hourly child care-oriented criteria to achieve 100% compliance. Respondents had spent 12 minutes or 20% of every hour doing hand washing (Clark et al., 2016). The transmission of person to person through contaminated hands and objects plays a key role in the spread of infection. Improved hand hygiene in caregivers and or children in day care centers (DCC) can result in a 31% reduction in gastrointestinal infections in children and a 21% reduction in respiratory infections (Van Beeck et al., 2016).

An intervention study by Hedin *et al* (2010) on hand washing found that in 17% of children in DCC use liquid soap and paper towels (Hedin et al., 2010). Childcare services play an important role in ensuring the wellbeing of children, these children's carers are responsible for providing care and education to this younger population in the absence of their parents or carers. Park *et al* (2014) conducted research on a comprehensive health care program for disease management infections in child care centers by medical doctors in Korea. The program focuses on implementing interventions in management, education, and health screening for teachers, parents, and children within a 12-week period. The frequency of utilization, cost, and day of prescription of drugs and antibiotics due to disease infections before intervention compared to those during the 3-month intervention, using health insurance claims data. Significant reduction (12%) in the day of visit related hospital infections were observed by intervention (incident rate ratio = 0.88, P = 0.01), and medical costs, day prescription medications, and antibiotic prescription days decreased, although not statistically significant (Park et al., 2014).

Good health in children can increase attendance, reduce absences, and bring the poorest and most disadvantaged children to school (Kericho & Rebecca, 2016). Study by Lary *et al* (2020) on the education of the importance of hand hygiene to get educational results and visitors (P < 0.001) (Lary et al., 2020). The study by Patrick *et al* (2010) designed to compare the transfer of bacteria through touch contact in childcare settings after participants used the usual hand drying procedure or a prescribed double hand drying system. The amount of bacteria translocated to the skin, food or fingers is reduced (96%). Children between the ages of 3 and 4 can be trained to use prescribed hand hygiene procedures, which significantly reduce bacterial transmission through touch contact (Patrick et al., 2010). While Angela Fraser *et al* (2015) conducted a study of the frequency of provider hand contact at child care facilities in North Carolina and South Carolina. The purpose of this study was to determine the frequency of surfaces touched by day care providers, to identify surfaces that should be cleaned (Fraser et al., 2015).

Correa *et al* (2012) conducted a study with the title handrubs for the prevention of infectious diseases among children in Colombia. The goal is to evaluate the effectiveness of alcohol-based hand rubs in reducing acute diarrheal disease (ADD) and acute respiratory infections (ARI) among children aged 1-5 years in day care centers with limited tap water. For ADD and ARI there was no difference in hazard ratio during the first trimester of research. In the second and third trimesters, significant reductions in ADD risk were found in interventions compared to control arms (HR = 0.55, P < 0.001 and HR = 0.44, P < 0.001). There was also a significant risk reduction for ARI in the second trimester (HR = 0.80, P < 0.05) and in the third trimester (HR = 0.69, P < 0.001) (Correa et al., 2012). Furthermore, the study by Chukwuemeka (2011) was conducted with the aim of determining the educational effects of hand washing and the promotion of routine hand washing in childhood diarrheal diseases and the absence of children in nursery schools in Nsukka, Enugu State. The intervention resulted in the incidence of diarrhea in the intervention group reduced to 5.7% after two weeks and to 6.9% after three months. Age, birth order, housing, home water

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supply sources, parental work and maternal education levels all have a statistically significant relationship with the onset of childhood diarrhea, both in intervention and control groups (By & Chukwuemeka, 2011).

Researcher Nwadiaro *et al* (2015) also gave good results on hand washing inventions. The promotion of hand washing in child care facilities or schools allows preventing infection by about 30% in diarrhea episodes (high-quality evidence), and can prevent similar proportions in school (low-quality evidence) (Ejemot-Nwadiaro et al., 2015). Furthermore, Zomer *et al* (2016) researchers conducted research on children on improving hand hygiene compliance in day care centers. A total of 5606 opportunities to supervise hand washing in children were observed. Interventions were developed to improve handwashing compliance and reduce infections in child care facilities, but no interventional effects were found on children's handwashing supervision (36% vs. 32%; or 0·64, 95% CI 0·18–2·33) (T. P. Zomer et al., 2016).

Biezen *et al* (2019) obtained the results of research on effective hand hygiene practices can reduce the transmission of diseases such as respiratory tract infections (RTI) and gastrointestinal infections, especially in young children. Participants agreed that hand hygiene practices are important in reducing disease transmission. Obstacles such as variations in hand hygiene habits relating to visibility to transmission, concerns around young children obsessing over hand washing, children being 'too clean' and the need to build up their immunity through exposure to dirt, and skepticism that hand hygiene practices can be achieved in children, all depend on participants' motivation to develop good hand hygiene behavior in young children (Biezen et al., 2019).

DISCUSSION

The studies studied in this systematic review are about handwashing interventions related to the knowledge of correct hand washing according to international standard procedures, hand washing habits in accordance with the set time for hand washing, environmental factors in child care facilities that are closely related to the incidence of infection. Infection problems that occur in children aged < 5 years old who are in child care facilities need to get special attention. In this case, health providers are very necessary to provide education, monitoring and follow up the correct hand washing habits in children, so that the risk of infection and pressure is significantly reduced.

The correct act of washing hands can reduce the absence of children in child care facilities, in addition to child development is also closely related to the disease suffered by the child. With comprehensive handwashing interventions implemented in childcare facilities, it has a significant impact on the decrease in the incidence of child infections as well as increased levels of child adherence to hand washing habits.

CONCLUSION

This study evaluated the effects of handwashing interventions on children < 5 years old who are in child care facilities. Of the twenty-five journals overall had a significant impact in relation to the risk of infection in the child. Most of the interventions in this study had a good impact on increasing children's knowledge of hand washing, correct hand washing patterns, adherence to time to hand washing as well as reduced microorganisms that were on hand as a result of the interventions carried out. Based on research from the fifteenth journal examined, the majority showed significant positive effects on the reduced risk of infection of children resented in child care facilities. However, in the study conducted

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by Gudnason *et al* (2013) no significant effects occurred in children after being given time-related handwashing interventions (Gudnason et al., 2013).

It is expected that the role of parents and other health providers should be more involved. In addition, several studies have also shown that a combination of hand washing interventions such as the provision of hand washing facilities, education and direct demonstrations about hand washing, hand washing posters are more effective in increasing knowledge about hand washing and its effects on the risk of infection in children (T. P. Zomer et al., 2016). therefore it is expected that in the next study the intervention of hand washing comprehensively and more creatively according to child development is developed more. In addition, the validity and reliability measuring instruments must also be improved. RCT studies should also continue to be conducted to find out the actual effects and to avoid bias in research.

CONFLICTS OF INTEREST

There is nothing conflicts of interest in this systematic review.

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