

## Review Article

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# Infecto-contagious diseases in day care centers: a systematic review

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## ABSTRACT

Agglomeration and contact among children in day care centers has increased; however, this population has a high level of immunological immaturity, which makes it vulnerable to respiratory and gastrointestinal pathologies. This work aimed to identify the factors predisposing infecto-contagious diseases in day care centers. This is a systematic review of the literature carried out in the international database Pubmed, using the descriptors: Causality, Communicable Diseases, Child Day Care Centers. After adding the descriptors in the database, 79 papers were generated, however only eight fit the criteria established in this study. Day care centers are ideal environments for the development of diseases of the respiratory tract and otitis media, but may be environments that reduce the risk of acute lymphoblastic leukemia and neuroblastoma. There are still few mechanisms to prevent and control infections in these environments.

**Keywords:** Causality, Communicable diseases, Child day care centers

## INTRODUCTION

There has been a significant increase in the number of child day care centers around the world.<sup>1</sup> The emergence and increase of day care centers are also linked to the insertion of women in the labor market, which made it impossible for them to dedicate exclusive care to their children, thus requiring the support of these places.<sup>2,3</sup> Day care center attendees are composed of preschoolers with a starting age of 0 to 4 years, who therefore present many vulnerabilities due to immunological immaturity and accelerated growth, and which require greater preventive care from the caregivers and teachers of the place.<sup>4</sup> It is still observed that children who are in day care centers get sicker than those cared for only in the home environment, due to less contact and exposure to diseases.<sup>5,6</sup> In the applied context, among the main

systems that affect this population in day care centers are the gastrointestinal and respiratory systems, associated mainly to cases of diarrhea and various acute respiratory infections, highlighting pneumonia as the most recurrent in these cases.<sup>7</sup>

Studies show that there is a high number of parasitic diseases and respiratory infections in day care centers and that if these cases are recurrent in children, it may result in a developmental delay, especially when poor diet and poor hygiene are present.<sup>8</sup> The factors that possibly explain the increase in the number of cases and facilitated contamination are associated with agglomeration and close contact with people, considering that in the majority, these environments are at their fullest capacity, favoring contact even more.<sup>9</sup> For this, it is necessary that the professionals who work in these places (such as cooks

and cleaning aids) to be able to work toward preventing possible transmissions. The teacher stands out as the mediator of these situations, who can work toward both prevention and control, but who can also be contaminated, as they may present low immunological maturity based on a diversity of factors.

Therefore, the present study aims to describe the main risks and benefits of infecto-contagious diseases in day care centers.

## METHODS

This is a systematic review of the literature that sought to identify the factors that predispose to infecto-contagious diseases in day care centers. The search for papers occurred between July 2016 and January 2017, in the *Pubmed* database. A selection of papers using a combination of the descriptors *Causality AND Communicable Diseases AND Child Day Care Centers* was performed.

### Selection strategies

The selection of papers followed the following inclusion criteria: (i) original papers, reviews and meta-analyses; (ii) in English; (iii) carried out in humans; (iv) and that

present the complete version. The selection process began with the exclusion of duplicate papers, then the manuscripts that presented complete text were selected, excluding dissertations, theses, letters and editorials. Soon after, application of the other criteria listed above was carried out, and entire manuscripts were read.

Reports and experimental studies with animals were excluded, considering these were not applicable to the criteria established for the purpose of this study.

### Prisma recommendation

To define and follow the steps of a systematic review, we based it on the PRISMA checklist and flowchart of 27 items, which is recommended by science for systematic reviews. The steps taken in this checklist add more credibility and reliability to data found in a systematic review.<sup>10</sup>

## RESULTS

The search carried out in the database *Pubmed* generated a total of 79 papers. After screening by reading titles and abstracts, 53 papers were selected for reading in full. Of these, 13 papers completed the inclusion criteria for this review (Figure 1).

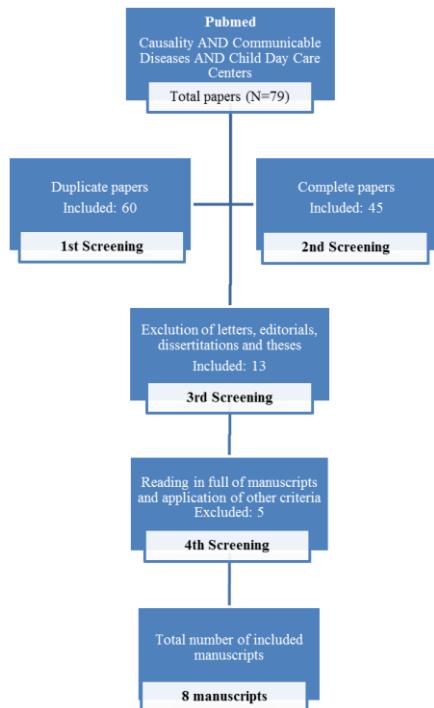
**Table 1: Main results of selected manuscripts.**

N	Authors	Year	Type of study	Objective	Main results
01	Enserink et al	2012	Prospective cohort study	To describe the purpose, design and potential of the national sentinel surveillance network focused on multicenter centers for infectious diseases	The KIZSS network has as a main objective to provide support for health services in support and control of infections in day care centers. This database collects information that serves to assess the burden of these illnesses associated with children and staff in the day care environment. The network can still subsidize the monitoring of future strategies directed at daytime actions in day care centers.
02	Urayama et al	2010	Metanalysis	To summarize the findings on the relationship between day care centers and the risk of childhood leukemia.	It was observed that the risk of childhood leukemia in day care centers is reduced, and that this factor may present changes based on the size and sanitary structure of the environment.
03	LaCross et al	2008	Controle case study	To explore the apparent diversity of colonizing, non-typeable <i>Haemophilus influenzae</i> by characterizing 46 putative isolates from the throats of two healthy children attended at the same day care center and reported in a previous study	<i>Haemophilus influenzae</i> bacteria showed high genetic variability among the studied children. The study demonstrates that this factor can increase the presence of infections in this population attending day care centers.

Continued.

N	Authors	Year	Type of study	Objective	Main results
04	Nesti e Goldbaum	2007	Review of the literature	To describe the increased risk of acquiring infectious diseases associated with out-of-home child care and the effectiveness of measures to control and prevent disease transmission in preschool and early childhood education centers.	Children who are cared for in day care centers or preschool education have a threefold risk of developing infections, reflecting on the health of the child and the community. The risk factors are associated with the characteristics of the school environment and can have simple solutions. The necessary measures are carried out around the correct hygiene of the students, as well as qualification of the professionals.
05	Lee e Young	2006	Retrospective study	To describe the pattern of infecto-contagious diseases among admitted children in a residential day care center and identify any clusters of unusual admissions.	Of the 267 children, 221 had infectious diseases, with 83.7% being of the respiratory tract, 7.2% with viral rash and 5.9% with gastroenteritis. Among the patients with respiratory tract infection, 22.7%, 9.2% and 8.6% presented respiratory syncytial virus, parainfluenza virus and influenza A or B virus, respectively.
06	Gilham et al	2005	Case control study	To test the hypothesis that reducing exposure to common infections in the first year of life increases the risk of developing acute lymphoblastic leukemia.	Reducing exposure to infection in the first few months of life increases the risk of developing acute lymphoblastic leukemia. This is evidenced by the exposure of children in day care centers, which, when exposed, decreases the risks to the pathology.
07	Menegaux et al	2004	Case control study	To investigate the relationship between day care care, childhood infections, allergies and neuroblastoma.	It has been identified that there is a reduced risk in day care, and that there is no association of neuroblastoma with common infectious diseases, such as chickenpox, mumps and measles, as well as allergies. It showed a small risk only for otitis media, and markers of potential childhood infections, suggesting a possible role of infectious agents in the etiology of cancer.
08	Berkelman, Guinan e Thacker	1989	Review of the literature	To review the medical, psychosocial and legal literature for the extension of health research and its impact of child care assistance.	Day care centers are environments that present high risks for children, with prevalence of respiratory tract infections and otitis. It is still observed that there is a high number of injury in poorly prepared environments of these places, such as handrails, playgrounds, followed by a poor diet. Child care in day care centers does not have health promotion and prevention activities.

The main results of the studies were organized so that the type of study, year, objective and main results could be analyzed (Table 1).



**Figure 1: Flowchart of the application of the systematic review process.**

## DISCUSSION

In a review carried out in the 80's, in order to evaluate the main exposures to which the child comes into contact with in the day care environment, it was identified that the most frequent infectious diseases acquired by children are those of the respiratory tract and otitis media.<sup>11</sup>

This factor is explained by the direct contact that the children have with each other, as well as by their adaptation period in the school environment as evidenced by Veríssimo.<sup>12</sup> In his study, the author noticed a greater amount of respiratory diseases, with pneumonia being more prevalent, followed by bronchitis, colds and then otitis.

Child abuse and neglect was also observed, based on psychosocial factors and physical structure of the environment, which enabled the increase in injuries, and in many cases, with referral to hospital units being necessary in many cases.<sup>11</sup> Inadequate feeding was also listed as a predisposing factor to the development of pathologies, which affects the growth and development of children.<sup>11</sup>

The manuscripts in this review concluded that in day care centers of the 1980s there was no implementation of health promotion and prevention, since there was no

tendency to inform about preventive acts or to carry out activities that control the main problems of the location.<sup>11</sup>

As evidence of previous hypotheses, in a review of the literature by Nesti and Goldbaum, it was identified that day care centers are environments that offer increased risk for the emergence of infections in children.<sup>9</sup> This fact is independent of the economic class and the characteristics of each individual, but depends on the factors that contribute to the spread of germs through the environment. In this case, the preschool environment may present a greater risk depending on the total number of enrolled children, the community in which it is located, if it has good sanitation and health conditions so as not to interfere in the day-to-day routines of these places, hygiene, size of classrooms, time spent in the facilities, number of employees per child, and educational and socioeconomic levels of families.<sup>9</sup>

Thus, it is corroborated by Oliveira, Brasil and Taddei in concluding that day care centers are environments that require greater sanitary rigor, both for their structure and for the food preparation environment of the place.<sup>13</sup> These factors, along with good general hygiene and sanitary practices of caregivers for protection, will enable quality child care and reduced risk of infection.

In addition to these factors, the child is presumed to have reduced immunity in the preschool environment, since they have yet to be vaccinated, or vaccines are otherwise neglected in some form.<sup>9</sup> The vaccination situation is still a serious problem due to the socioeconomic situation of the children's parents, as Lima et al state, affirming that the delay, not vaccination, is due to this problem.<sup>14</sup> Even so, this hypothesis is coupled with the distance between the community from health professionals and the education of public institutions, thus allowing disinformation and consequently the appearance of greater infections in the children.

Nesti and Goldbaum also state that among the pathologies that affected children, the respiratory system, multiple organs with invasive bacterial diseases, gastrointestinal system and liver stand out as higher risk, and at lower risk, viral and skin diseases.<sup>9</sup> Therefore, children attending child day care centers are at increased risk of respiratory infections, acute otitis media, diarrheal disease, bacterial invasive disease caused by *Haemophilus influenzae* and *Streptococcus pneumoniae*, hepatitis A, cytomegalovirus and varicella zoster infections.<sup>9</sup> Furthermore, that there are risk factors in child manipulation procedures, such as changing diapers, bathing and other activities, have also been observed. These factors, associated with the need to perform tasks that are simultaneous or close to one another, such as cooking, cleaning the environment and children, may contribute to the development of infections.<sup>9</sup>

The prevention suggestions found in the study were to promote the health of children and staff, assisted by

medical supervision and immunization, hand hygiene, correct diaper change, avoidance of direct contact with bodily secretions, making use of protective materials, proper cleaning of surfaces and objects, with the need for staff specifically for this purpose, the hygienic handling of food, the removal of children or staff with infectious diseases, notification and training of professionals to control infection.<sup>9</sup>

In a study by Lee and Young at a day care center in Hong Kong, China, a survey was carried out on children who were attended by a day care center and who were admitted to hospitals.<sup>15</sup> A total of 267 children were admitted to this day care in a 5 year period, 221 of whom had infectious diseases, mostly respiratory tract infections, viral rashes, and gastroenteritis. In patients with respiratory tract infection, the most common viruses were the syncytial, parainfluenza and influenza A and B.

In this sense, it was observed that children cared for in day care centers were more susceptible to infections, especially respiratory ones, because of the clustering of students in these places. A comparison was also made between these and children who are cared for in residential settings, where in these cases the infections are stronger, and in day care centers infections are milder.<sup>15-18</sup> However, Lee and Young concluded that all day care children are at constant risk from respiratory diseases, so these environments should provide simple prevention measures.<sup>15</sup>

Regarding respiratory diseases, LaCross et al studied nontypeable *Haemophilus influenzae* (NTHi) in two children from a day care center cited in the previous study. NTHi is a gram negative, cocobacillary, facultative aerobic, bacteria and has previously been described as responsible for the common flu; currently, influenza is defined as being caused by the *Influenzae* virus, with the use of vaccines drastically reducing the number of people infected.<sup>19</sup>

In this sense, knowing that day care centers offer a suitable environment for the appearance of these infections, it was decided that the genetic variability of this bacteria in the respiratory tract of children, mainly in the pharynx, be analyzed. High levels of genetic diversity have been demonstrated that colonize the pharynx of healthy children and indicate that the results obtained from small samples mirror the results of larger collections, proving that this high variation may present greater susceptibility to the onset of infections.<sup>19</sup> In Brazil, Oliveira identified that more than 70% of the children in an inland day care center were infected with NTHi, thus proving that day care centers are conducive to the appearance of this virus in children.<sup>20</sup>

Based on the premise that day care centers may increase the risk of developing infections, Gilham et al conducted a study in the United Kingdom and found that early exposure of children to infections reduces the risk of

acute lymphoblastic leukemia (ALL) and that this may be important for the child's health.<sup>21</sup> Children who had daily contact with other children appeared to be more immunized than those who only had one contact per week or none at all. This effect is even lower in cases of 2 to 5 years of age, where the ages are higher and ALL takes place after the appearance of several infections.<sup>21</sup> Confirming this result in a meta-analysis, the authors analyzed childhood ALL and its association with the time period in which the children started day care. Fourteen manuscripts were evaluated and after the statistical analysis, it was observed that care in the day care center offers a reduced risk of childhood ALL. However, in the analyzes of the subgroups, it was identified that the greatest risk reduction occurs when child care is started less than 6 months of age. Furthermore, the study showed that children who spent most of the day in day care have a lower risk of developing childhood ALL infection compared to those who spent less time; however, there is still no scientific evidence to confirm the association between these results.<sup>22</sup> The child may undergo a deregulated immune response during the first months of life, leading to an increased risk of ALL, and this can be reduced through early insertion in day care.<sup>21,22</sup>

However, this reduced risk may vary depending on the capacity for child care and the child care standard offered to the child, associated with the individual factors for the development of infections, such as age, frequency, length of stay, structure and size of the facility.<sup>21,22</sup> These factors may be associated with the child's immune system, which the earlier they are inserted in day care, the greater the likelihood that their bodies will biologically adapt to the environment, thereby reducing the risk of infections, making them more resistant. In contrast, the development of infectious diseases associated with institutionalization may negatively affect the nutritional status of schoolchildren, since some intestinal diseases tend to reduce their hydroelectrolytic balance, thus causing them to have a fragile health. In this sense, it can be concluded that day care children present immune responses that are more resistant to some pathologies, but are more susceptible to others.<sup>21-23</sup>

When analyzing neoplasias, a study by Menegaux et al shows that among the most present in children is neuroblastoma, which is an embryonic malignancy of the sympathetic nervous system derived from primordial cells of the neural crest.<sup>24</sup> It was identified that this neoplasia has its most potentiated diagnosis in the first 3 months of life. The etiology of neuroblastoma is not well known and thus Menegaux et al, when analyzing that the diagnosis is found more frequently in newborn children, decided to analyze the factors to which they are exposed in the period.<sup>24</sup> In their results, it was observed that the most frequent infections in children such as mumps, chickenpox, measles, have no association with the neoplasia, as well as some allergies. It was also found that infections in general did not increase the risk of

developing neuroblastoma, even though the study showed a strong correlation for ear infections.

Breastfeeding, although not a point studied in depth by researchers, has been shown to be an important protective factor because it transmits antibodies through the milk, giving the child more immunity.<sup>24</sup> Regarding the children attending day care centers, they observed a decreased risk of developing these neoplasias, which indicates that these environments may be positive sites for the prevention of neuroblastoma. However, in order to consolidate this fact, it is necessary to carry out other studies that may analyze the issue of day care more in depth.<sup>24</sup> The authors also noted that children who were breastfed and who were in day care centers also had reduced risk; however, most of the mothers worked and had a higher income. These factors cannot be ruled out, considering that socioeconomic condition influences care and health.<sup>24</sup> Breastfeeding is a proven protective factor for children and can reduce the risk of infections, as it makes them more nourished and thus better able to avoid the development of allergies and exposure to other diseases of the respiratory tract.<sup>25-27</sup>

In order to address the problems involved in day care centers and other child care establishments that have been considered a public health issue since 1984, Enserink et al present a network that, through various information collected in databases, associates infecto-contagious diseases and relates them to the role of employees and students.<sup>28-30</sup> Taken together, this information may reduce cases of child infections in day care centers.

Thus, the Dutch National Institute for Public Health and the Environment (RIVM) maintains a network of sentinel surveillance based on day care centers for infectious diseases throughout the Netherlands, called the KIZSS network. Its implementation is divided into 8 steps, ranging from the interviews of socioeconomic profiles of each child, prior illnesses, medical consultations and the entire history of health to microbiological collections, with the purpose of performing molecular detections for bacterial, viral, parasitic pathogens, and finally performs a statistical analysis that cross-references the data in order to correctly assign the calculations to the days when the children do not go to day care centers or the days that they are supposedly recovering from the infections.<sup>30</sup> According to the authors, the KIZSS network, however, may take a longer time for the results, since its application has an average of 3 to 4 years and only after proving its effectiveness can be observed the real effectiveness be observed in the cases of infections in day care centers.

Strategies for the prevention of infectious diseases in day care centers should be studied, developed and applied with greater depth, as this will provide quality care, promote health and prevent diseases in this environment, making them safe places for child care and thus allowing a quality of life for children, parents and caregivers.

The selected studies show that care centers for children (day care centers) present risks related to infectious diseases since the last century, with those of the respiratory tract being the most prevalent, followed by otitis media. Respiratory diseases, in turn, are due to the constant presence of the non-typeable *Haemophilus influenzae* virus (NTHi).

In contrast, this environment is beneficial for the prevention of cases of Acute Lymphoblastic Leukemia (ALL), since studies have shown that the exposure of children to day care centers considerably reduces the risk of developing ALL, and that this fact is independent of social and economic factors. There are still few strategies to prevent and combat infections in day care centers, and only one network in the Netherlands is being tested and gradually implemented in the country.

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