

ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Factors that are associated with the development of acute respiratory infections in the kindergarten – an analysis of the population of 1,528 children

Radica Tasić¹, Divna Kekuš¹, Nataša Rosić²¹Medical College of Applied Sciences, Belgrade, Serbia;²Institute of Public Health, Belgrade, Serbia**SUMMARY**

Introduction/Objective Acute respiratory infections (ARI) are very common amongst children attending preschool institutions (PIs) and they represent a significant public health problem. Strict compliance with the legal regulations should reduce the incidence of respiratory infections in children.

The aim of this research was to determine predictors for the appearance of ARI in kindergarten.

Methods The research was conducted as a cross-sectional study at the six PIs located on the territory of Voždovac municipality during a six-month period (from January to June 2016). The target population consisted of 1,528 children who were between three and seven years old. Data analysis was done using descriptive statistics (χ^2 test and Spearman's rank correlation coefficient).

Results The increase in the number of children for 30% above the norm was a predictive factor for the increase of respiratory infections ($p < 0.001$). Sex differences were not a predictive factor for the emergence of respiratory infections in any age group. In all organizational units, March was the period when respiratory infections were on the increase (37.2%, $p < 0.001$), and it was significantly higher ($p < 0.001$) in cases, when the diseased child had a brother and/or a sister in the same kindergarten. During the observed period, the number of teachers corresponded to the range of one educator per 12 to 19 children. A constant number of educators could not reduce the incidence of respiratory infections, especially during the February–March period ($p < 0.001$).

Conclusion In addition to active treatment and strict compliance with the legal regulations in the organization of PIs, the reduction in incidence of respiratory infections in preschool children could be achieved if the number of enrolled children complied with the standard, as well as by preventive procedures in children's groups: avoiding overheated and dry air, regular ventilation, fresh air, well-planned diet, physical activity, personal hygiene and cleanliness.

Keywords: kindergarten; respiratory infections; predictors

INTRODUCTION

Preschool upbringing and education of children in Serbia is regulated by the Law on the Education System Foundations, as well as the Law on Preschool Education within the framework of a unified system of education that is in accordance with the Constitution and ratified international conventions, such as Convention on the Rights of the Child, which emphasizes the rights of preschool children to develop, as well as meeting their educational, cultural, health, and social needs [1, 2]. In addition to educational work with children as defined by the law, preschool institutions (PIs), which comprise of nurseries and kindergartens that provide daycare accommodation, meet the needs of preventive health care, nutrition and social protection of children as well. These functions are performed by nursery and kindergarten teachers. At the level of PIs, there are pedagogues, psychologists, speech therapists, social workers, dietitians, and nurses, who work on prevention and, if necessary, other associates.

The preschool age of a child carries specific risks of increased incidence of acute respiratory

infections (ARI). Primarily, there is decreased ability to produce antibodies for certain groups of bacteria, given the dynamics of the production of Immunoglobulin G antibody subtypes. Immunoglobulin G2 antibodies work on bacteria with a polysaccharide capsular membrane, and their maximum level of action is expressed at the age of 12 [3]. Staying in children's nurseries, where children are in contact with peers of the same age, leads to a greater exposure to potential sources of infection. In children's groups with the mixed age structure, this danger is lower, and thus is the incidence of respiratory tract infections. In addition, older children have already adopted hygienic habits, and there is less chance of spreading the infection with dirty hands, by the secretion from the nose and mouth.

Children who are not in the system of daycare accommodation institutions like kindergarten, mostly suffer from viral infections. On the other side, children who are in daycare accommodation suffer equally from viral, bacterial, and mixed infections. The risk of respiratory infections is three times higher in the age group between two and five, compared to children of the same age who are at home, and it is more frequent in the

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urban population group. The early enrollment to nursery is associated with frequent childhood illnesses (averagely up to three times a month). For the first time, those children are in contact with a larger number of children, whereas some of whom have a cold, some are in the infectious disease incubation, and some are healthy [4, 5]. Only after the third year of stay in the collective, the incidence of illness falls to the incidence rate of children who do not attend kindergarten. After a three-year-old child goes to the kindergarten for the first time, he is exposed to one or two episodes of airway inflammation annually, and after two years, the frequency decreases to the level of children who do not attend the kindergarten. Children who have an older brother or sister, who attends kindergarten as well, meet these diseases at home, and when they go to the kindergarten, they are less likely to be sick.

The aim of this research was to determine factors that are associated with the appearance of ARI among children who are attending daycare accommodation in the kindergarten.

METHODS

The research was conducted as a cross-sectional study at the Čika Jova Zmaj PI in Belgrade, which organizes and delivers daycare in 29 kindergartens in the area of Voždovac municipality. This study was conducted from January to June 2016, in six kindergartens that belong to the Čika Jova Zmaj PI (Čika Jova Zmaj, Plavi Čuperak, Sestre Bukumirović, Mala Sirena, Vivak, and 1001 Radost), which presents 20% of all kindergartens (6/29). A total of 1,528 children were enrolled there (739 girls and 789 boys, 48.4% vs. 51.6%), and they were organized in sixty educational groups. This number of children accounts for 35% of all enrolled children within this PI, and 40% of all educational groups. Internal questionnaires were used for the purposes of this research, as well as records and workbooks for each educational group. Socio-demographic data on the age, sex, and siblings in the family were retrieved from these records. In addition, we used data on the number of children enrolled in educational groups in relation to age; the total number

of children enrolled at each kindergarten (all groups); the prescribed legal norm of the maximal number of children that could be enrolled in one particular kindergarten (it is determined by the capacity of the kindergarten) and the number of absent children from the group due to the ARI (ill episode). Data on the number of engaged educators per group were also recorded on a daily basis at each kindergarten.

Data analysis was performed using descriptive statistical methods. Results were presented in absolute numbers and as percentages. χ^2 test was used to assess statistically significant differences between groups. Spearman's correlation analysis was used to assess significant correlations. The line graph was used to present the most important findings. All data were analyzed using SPSS 20.0 (IBM corp., Armonk, NY, USA) statistical package and MS Excel 2007 (Microsoft Corp., Redmond, WA, USA). Statistical analysis was based on the probability level of 95%.

All procedures performed in the study were in accordance with the institutional Committee on Ethics.

RESULTS

The number of children enrolled in six kindergartens within the Čika Jova Zmaj PI during the observed period from January to June 2016, compared to the prescribed norm for the ages of three, four, five and six is shown in Table 1, while the number of registered ARI in kindergartens in this period are shown in Table 2.

In every kindergarten, the number of registered children was higher than the number that is recommended by the norm in all age groups. Mala Sirena kindergarten was leading when it came to the number of children enrolled. There were 441 children in total, or 32% children more than the envisioned norm in the period from January to June 2016. During this period, there were 678 cases of registered ARI, and on average, it is 47% more infections compared to other kindergartens (Figure 1). Correlation analysis found that there was a statistically significant association between the number of children above the norm and the occurrence of

Table 1. The number of enrolled children, the norm, and percentage of difference (%)

Age	The number of enrolled children / the norm (% difference)						Total
	Čika Jova Zmaj	Plavi čuperak	Sestre Bukumirović	Mala sirena	Vivak	1001 Radost	
3	63/52 +21%	31/20 +55%	69/40 +73%	146/100 +46%	33/20 +65%	84/60 +40%	426/292 +46%
4	36/24 +50%	68/48 +42%	66/48 +38%	92/72 +28%	35/24 +46%	64/48 +33%	361/264 +37%
5	36/24 +50%	56/48 +17%	87/68 +28%	112/72 +56%	11/12 -8%	85/72 +18%	387/296 +31%
6	33/24 +38%	72/48 +50%	75/48 +56%	91/72 +26%	24/24 0%	59/48 +23%	354/264 +34%
Total	168/124 +35%	227/164 +38%	297/204 +46%	441/316 +40%	103/80 +29%	292/228 +28%	1,528/1,116 +37%

Table 2. The number of acute respiratory infections (ARI) episodes in six kindergartens in the period from January to June 2016

Number of ARI episodes	Čika Jova Zmaj	Plavi čuperak	Sestre Bukumirović	Mala sirena	Vivak	1001 Radost	Total
Total in the observed period	186	275	249	678	127	347	1,862
Average number per month	31	45.8	41.5	113	21.2	57.8	310.3

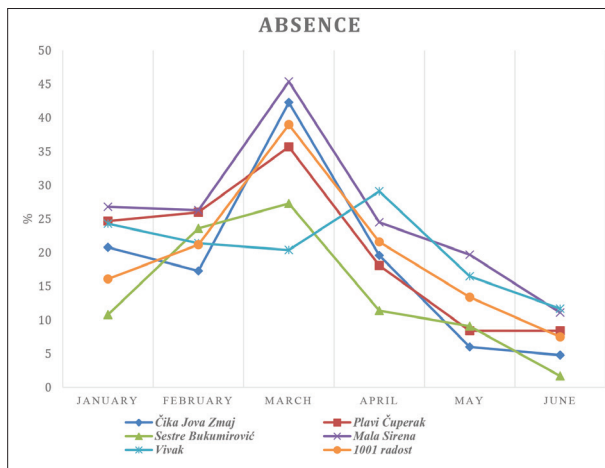


Figure 1. The absence of ill children in the observed period for each kindergarten

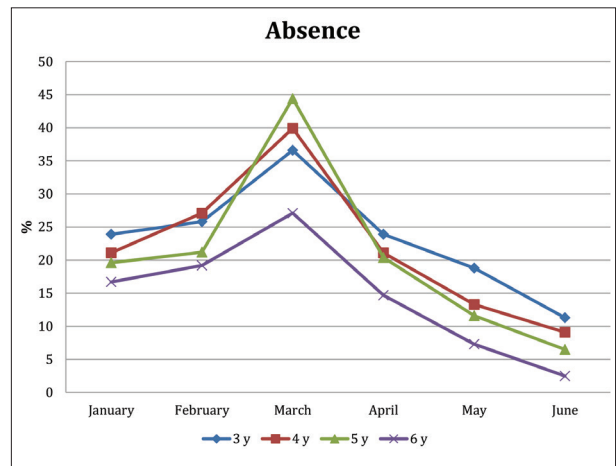


Figure 2. The absence of children in the observed period for all kindergartens

ARI ($\rho = 0.475$; $p < 0.001$). Figure 2 presents the illustration of the total absence of children between three and six years due to ARI during the observed period for six kindergartens covered by the observed sample in Čika Jova Zmaj PI. In the group of preschool children, the highest number of respiratory infections was registered in the period from January to April, with a peak in March.

Number of registered absences due to the ARI ill episodes in all kindergartens during the six-month period, and characteristics of children, in terms of their sex and whether they have siblings in the same kindergarten, is presented in Table 3. There was no statistically significant difference in relation to the sex of children, while statistically higher incidence of ARI was registered among children who had a brother and/or sister in the same kindergarten, in comparison to those who did not ($\chi^2 = 29.864$; $p < 0.001$).

As shown in Figure 3, the incidence of ARI in all six kindergartens was highest in March, 37.2% ($\chi^2 = 172.069$; $p < 0.001$), with the tendency to decline toward June, when just 7.5% were absent due to the ARI ($p < 0.001$). During the observed period, a constant number of teachers was present in six kindergartens at the Čika Jova Zmaj PI level, despite the fact that there were 25–45% less children than usual, just due to the ARI ($\rho = 0.492$; $p < 0.001$).

Table 3. Number of registered absences due to acute respiratory infections (ARI) episodes in all kindergartens during the six-month period and characteristics of children

Children characteristics	Number of children registered as absent due to ARI						Total number of registered absences
	January	February	March	April	May	June	
Sex							
Female	152	192	275	152	98	52	921
Male	161	166	293	157	101	63	941
Siblings in the kindergarten							
No	117	138	225	118	75	51	724
Yes	196	220	343	191	124	64	1138
Total	313	358	568	309	199	115	1862

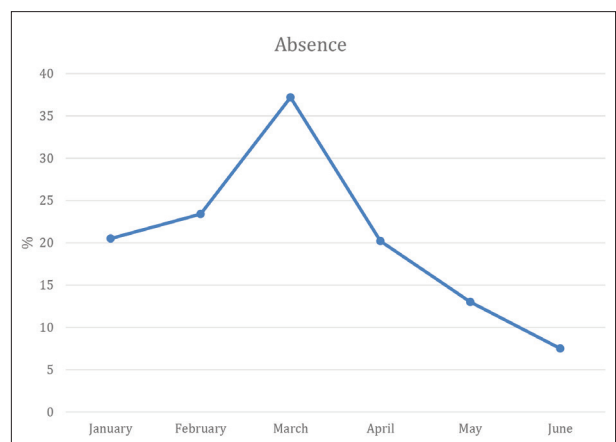


Figure 3. The absence of children in all kindergartens, all ages, during the observed period

DISCUSSION

The results of our study indicate that an increase in the number of children above the norm by 30% is a statistically significant preemptive factor for the increase in respiratory infections ($p < 0.001$). The sex of a child in any age group was not a predictive factor for the emergence of respiratory infection.

In all organizational units, March was the period when there was a statistically significant ($p < 0.001$) increase in respiratory infections and it was significantly higher ($p < 0.001$) in cases when the ill child had a sibling in the

same kindergarten. During the observed period, the number of educators corresponded to the range of one educator per 12–19 children. A constant number of educators due to the number of children, which was above the norm, could not reduce the incidence of respiratory infections, especially in the period from February to March ($p < 0.001$). In the observed period from January to June 2016, the maximum incidence of respiratory infections was in March at 37.2%, with the tendency to decline to 7.5% in June ($p < 0.001$).

The consequences of respiratory infections of children attending PIs represent a significant public health problem. The ill child has to remain at home and be cared for until it recovered. It implies that one parent has to take days off work and stay at home as well, which causes work absenteeism, if there are no available family members who would look after the ill child (usually grandparents). This type of infections requires medical checkup and often prescription of antibiotic therapy, which implies certain costs. By changing the norm (by increasing the size of the space in which children stay and creating age-mixed groups), the rate of respiratory infections could be reduced. In Denmark, children enter the national kindergartens at the age of 18 months [6]. In the age group of 18–24 months, there are six children in the group, who are looked after by two people, while children 24–36 months are in groups of 12 with two educators assigned.

The risk degree for airway inflammation is three times higher in the group of children, who are two and a half years old in kindergartens, compared to the group of children of the same age, who are at home [7–10]. A Swedish group of authors state that children attending classical kindergartens are twice as likely to be absent due to illness, compared to children in small groups of three to six children [11]. Similar results are also found by an American Prospective Study, where the frequency of respiratory infections was monitored in three groups of children; the first group consists of children who do not reside in the collective daycare; the second group of children who were accommodated in family groups of two to six children; and the third group consisted of children who were attending classic kindergartens with more than seven children in the group [12]. In the third group of children aged two, there was significantly higher incidence of respiratory infections. This difference disappears after three years of residence in the collective. Danish authors did not find the connection between the amount of time children spend outdoors and in the kindergarten. However, they did find that the higher level of hygiene standards has an effect on reducing the incidence of respiratory tract infections [6]. This study shows that about 30% fewer sick days are present with children under parental care, who do not attend classic kindergartens. Chinese authors found higher risk of ARI in the group of children with allergies [13].

Within one year, out of 100 children suffering from ARI, 58 children were in kindergarten, while additional 12 were ill because of an older sibling who has been sick in the nursery. Only 30 of them had no contact with the group and they were infected by another source (inside the household 83%, neighborhood 11% and unknown 6%). Bacterial inflammation of the airways is dominant in kindergarteners, whose treatment requires the use of antibiotics, which increases the cost of treatment [12, 14].

Therefore, special significance has to be given to preventive procedures in children's collectives: avoiding overheated

and dry air, regular ventilation, fresh air, well-planned nutrition, physical activity, personal hygiene, and cleanliness. Hygienic habits are an important factor in the emergence of infectious diseases in children's collectives. Thus, washing hands (a child or an educator) after wiping the nose, changing diapers, before feeding, or preparing a meal is to a large extent statistically associated with an increased incidence of respiratory illnesses [15, 16]. The equal degree of association exists regarding the claim that there are greater chances of ARI when using a commonly used towel (instead of paper towels), as well as when washing blankets less than once a week [17]. Pan et al. [18] find that increasing age of children and higher paternal education are associated with lower risk of bacterial carriage.

By changing the norm (by increasing the size of the space in which children stay and creating mixed age groups), the amount of infectious diseases could be reduced. It is also necessary to consider the socioeconomic justification of the early departure of children into nurseries (already at the age of six months), especially having in mind the spatial and staff inadequacy of the institutions for the care of infants. It should be emphasized that the cost of nursing care for a sick child is considerably higher than that of a child who stays at home because they often have someone to take care of them during the absence of their parents (unemployed parent, grandmother, etc.). In our conditions, the direct costs, the cost of sick leave (without indirect costs) and the kindergarten costs, triple the cost of treatment.

CONCLUSION

Respiratory infections at preschool age present a specific sociomedical and public health problem that could be prevented to some extent. The population of children of preschool age during the first phase of staying in a collective goes through the process of adaptation and separation from parents. The probability of early prevention is significantly reduced if we consider staying in a group during the incubation period of respiratory infections. Frequent lack of understanding of employers for the absence of parents, who need to take care of their children, causes the reduction of time used for treatment. Thus, insufficiently recovered children are often sent back to kindergarten, which causes the increased risk of repeated infection. It further induces a longer absence of parents from work in order to take care of an ill child. Therefore, strict adherence to the regulated norms of the organization of PIs and preventive measures in order to keep down respiratory infections during the winter time could be the basis for the reduction of the number of children, who suffer from respiratory infections.

Conflict of interest: None declared.

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Фактори удружени са појавом акутне респираторне инфекције у предшколским установама – анализа популације од 1528 деце

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САЖЕТАК

Увод/Циљ Последице акутних респираторних инфекција деце која похађају предшколске установе представљају значајан јавноздравствени проблем. Стриктно поштовање прописаних норматива и превентивних поступака у деčјим колективима довело би до смањења стопе респираторних инфекција код деце.

Циљ нашег истраживања био је одређивање предиктора за настанак акутних респираторних инфекција у вртићу.

Метод Истраживање је спроведено као студија пресека у предшколској установи на подручју општине Вождовац током периода јануар–јун 2016. године. Циљану популацију чинило је 1528 деце узраста од три до седам година уписаних у шест вртића. Анализа података вршена је методом дескриптивне статистике (χ^2 и Спирманов тест).

Резултати Повећање броја деце изнад норматива за 30% предикторни је фактор за пораст респираторних инфекција ($p < 0,001$). Пол детета ни у једној узрасној групи није предикторни фактор за настанак респираторне инфекције.

У свим организационим јединицама март је период када долази до пораста респираторних инфекција (37,2%, $p < 0,001$), значајно више ($p < 0,001$) у случајевима када оболело дете има брата и/или сестру у истом вртићу. Током периода праћења број васпитача је одговарао опсегу једног васпитача на 12 до 19 деце. Сталан број васпитача није могао да смањи учесталост респираторних инфекција, посебно у периоду фебруар–март ($p < 0,001$).

Закључак Поред активног лечења и стриктног поштовања законских прописа у организацији предшколских установа, смањење учесталости респираторних инфекција у предшколском узрасту се постиже превентивним поступцима у деčјим колективима: избегавање прегрејаног и сувог ваздуха, редовно проветравање, боравак на свежем ваздуху, добро планирана исхрана, физичке активности, лична хигијена и хигијена простора.

Кључне речи: предшколске установе; респираторне инфекције; предиктори