ORIGINAL ARTICLE

A comprehensive analysis of anthropometric indicators in preschool children suffering from recurrent respiratory infections

Oleksandr M. Voloshyn[1,2], Yurii V. Marushko[1], Tetiana V. Hyshchak[1], Iryna I. Savchenko[2]
[1]BOGOMOLETS NATIONAL MEDICAL UNIVERSITY, KYIV, UKRAINE
[2]LUHANSK STATE MEDICAL UNIVERSITY, RIVNE, UKRAINE

ABSTRACT
Aim: To determine the state of relationship between anthropometric indicators and susceptibility to recurrent respiratory infections in preschool children.
Materials and Methods: A total of 143 children (73 boys and 70 girls) aged 12-59 months, undergoing inpatient treatment on acute respiratory infection, were involved in the clinical study. The number of acute respiratory infection episodes during a previous year of their lives was taken into account. Besides, the basic indicators of physical development were assessed in the children, including: 1) body weight; 2) body length; 3) chest circumference; 4) body mass index; 5) body surface area; 6) Vervek's index.
Results: Cross-tabulation and rank correlation analysis did not demonstrate any interdependence between the susceptibility of the children examined to recurrent respiratory infections and their anthropometric indicators. Simultaneously, linear regression analysis showed that in the children aged 12-23 months, resistance index depended on their age and body length. The relative importance of the combined effect of the two above-mentioned indicators among all other potential risk factors for recurrent respiratory infections was 32.2%.
Conclusions: The detailed analysis of the findings outlined the methodological basis for further studies of the association between the incidence of acute respiratory infections in preschool children and their physical development. Multivariate statistical calculations of various risk factors for recurrent respiratory infections, including abnormal anthropometric indicators, are likely to increase the informational value of subsequent examinations.

KEY WORDS: preschoolers, physical development, repeated acute respiratory diseases

Wiad Lek. 2024;77(4):724-731. doi: 10.36740/WLek202404117 DOI

INTRODUCTION

Acute respiratory infections (ARI), commonly diagnosed in preschool children, are considered to be one of the most pressing health challenge worldwide [1-3]. Characteristically, high incidence rates of ARI are directly and closely correlated with low levels of economic well-being in the population [2,4]. It is also worth noting that ARI is the leading cause of child mortality [5]. Globally, about 20% of all deaths among patients aged under 5 years are caused by ARI, most often in the form of severe pneumonia [6].

Parents and doctors, especially pediatricians, infectiologists and immunologists, are concerned when a child suffers from repeated or recurrent respiratory infections (RRI). Children with RRI pose a serious socio-economic burden for their families and society as a whole [7,8]. According to data published by G. Pasternak et al., RRI is diagnosed in 10-15% of child population [9].

Numerous reports were published on a large number of different factors (perinatal, individual, family, household, environmental, socioeconomic, etc.) contributing to frequent ARI episodes, especially in preschoolers [7,10-12]. In particular, these factors include significant deviations in their physical development from normal values. Specifically, it was reported that malnutrition is an important predictor of the increased incidence of lower respiratory tract infections in the children aged under 2 years [2]. Also, there was an evidence of relationship between ARI incidence in the children and their growth retardation frequency [13]. On the other hand, obesity in the pediatric patients also increases the likelihood of ARI [14]. However, the other findings showed no association between overweight or obesity in the children and the increased risk of hospitalization due to ARI [15].

Summing up all the above, further studies of the combination of abnormal anthropometric indicators and increased susceptibility of children to RRI are quite reasonable.

AIM

To determine the state of relationship between anthropometric indicators and susceptibility to recurrent respiratory infections in preschool children.

MATERIALS AND METHODS

The observational case-control study was undertaken in the pediatric somatic departments of the multi-field hospitals in the cities of Rubizhne, Kreminna and Sievierodonetsk, Luhansk region (Ukraine) in 2019-2021. An examination of 143 children (73 boys and 70 girls) aged 12-59 mos. hospitalised with ARI was carried out. According to the patients' anamneses, they had 1 to 15 ARI episodes during a previous year of their lives, including the current case.

The criteria for including children in the observation group were as follows: 1) gender - male and female; 2) age - from 12 completed mos. to 59 mos. 29 days; 3) ARI diagnosed with involvement of upper or lower respiratory tract; 4) body weight (BW) and body length (BL) of the patients examined were within (1-99)% range according to the current WHO standards [16]; 5) the absence of any diagnosed chronic disease; 6) the presence of informed parental consent to scientific study on a child; 7) children were not enrolled in other clinical trials.

Two integral clinical indicators were calculated for each patient: 1) modified infection index (InI) as the ratio of the number of ARI episodes during a previous year to a child's age, expressed in mos.; 2) resistance index (RI), representing the average number of ARI episodes per 1 mo. of a previous year. Apart from that, the basic anthropometric indicators of the children examined were measured and computed: 1) BW; 2) BL, 3) chest circumference (CC), 4) body mass index (BMI) by Ketle; 5) body surface area (BSA) by Dubois; 6) body proportion index by Vervek.

The recorded anthropometric indicators (BW, BL, BMI) were compared with standard percentile ranges [16]. The attribution of the integral anthropometric parameters (BW/BL, BW/age, BL/age, BMI/age) to particular standard deviation intervals or Z-intervals was determined with special software - "WHO Anthro" [17].

The study was conducted in accordance with the principles of the Declaration of Helsinki (2013). The local ethics committees of Bogomolets National Medical University (Kyiv, Ukraine) and Luhansk State Medical University (Rubizhne, Ukraine) approved the study protocol.

The statistical processing of the digital data was performed using the IBM SPSS Statistics 28 licensed software (USA). The Shapiro-Wilk test was used to verify whether the interval indicators complied with the normal distribution law. After that, such non-parametric characteristics as median (Me), Q_1 (25%) and Q_3 (75%) quartiles, quartile variation (V_q), minimum (X_{min}) and maximum (X_{max}) values of the indicator were used to describe the variation series.

Besides, the statistical computations included Kruskal-Wallis H-test, rank correlation analysis with the Spearman's coefficient (ρ) calculation, cross-tabulation with the Cramer's coefficient (φ_c) calculation, and linear regression analysis. In rank correlation and regression analyses, 95% confidence interval (CI) for the main coefficients was taken into account. The results obtained were considered significant if their asymptotic significance was less than 0.05 ($p<0.05$).

RESULTS

Initially, all the children examined were divided into four age subgroups: I - 12-23 mos., II - 24-35 mos., III - 36-47 mos., IV - 48-59 mos. (Table 1). As shown in this table, the total number of boys and girls in the observation group was almost equal. However, there were significant differences regarding the ratio between them in the age subgroups. Also, for all the patients examined, 6 ARI episodes per year was chosen as the threshold number to divide them into 2 frequency subgroups. Children who experienced 1-6 ARI episodes (subgroup A) in a previous year dominated over those who had more ARI episodes (subgroup B). The total number of patients with more frequent ARI episodes was almost 2.6 times lower as compared to those with less frequent ARI episodes. In children of subgroup I, the current episode of ARI was most often in the form of obstructive bronchitis (35.5%). Among the patients from the other age subgroups, community-acquired pneumonia was the most common diagnosis (Table 1).

The basic descriptive statistics for the anthropometric indicators taken into consideration are presented in Table 2. It was noteworthy that in all the age subgroups, low values of quartile variation were found for all these indicators, not exceeding 12%. With that, the V_q values for InI and RI in the children of different ages were significantly higher ranging from 24.22% to 39.93%. This evidenced a significant differentiation of the patients from all the age subgroups by the number of ARI episodes in their cases history (Table 2).

The Kruskal-Wallis H-test showed a difference between the age subgroups on InI ($H=35.013$; $p<0.001$) and RI ($H=10.072$; $p=0.018$). It was notable that for InI the average rank of its values decreased from subgroup I to subgroup IV. For RI, on the contrary, this rank decreased from subgroup IV to subgroup I.

Table 1. General characteristics of the examined children

Characteristic	Examined children				Total, n (%)
	Subgroup I, n (%)	Subgroup II, n (%)	Subgroup III, n (%)	Subgroup IV, n (%)	
Gender:					
- male	17 (54,8)	17 (44,7)	17 (41,5)	22 (66,7)	73 (51,0)
- female	14 (45,2)	21 (55,3)	24 (58,5)	11 (33,3)	70 (49,0)
ARI episodes p.a.:					
- 1-6 (subgroup A)	26 (83,9)	28 (73,7)	28 (68,3)	21 (63,6)	103 (72,0)
- 7 and ↑ (subgroup B)	5 (16,1)	10 (26,3)	13 (31,7)	12 (36,4)	40 (28,0)
Current diagnosis:					
- rhinopharyngitis	3 (9,7)	4(10,5)	3 (7,3)	5 (15,2)	15 (10,5)
- laryngopharyngitis	-	-	2 (4,9)	1 (3,0)	3 (2,1)
- laryngotracheitis	-	2 (5,3)	1 (2,4)	1 (3,0)	4 (2,8)
- acute bronchitis	7 (22,6)	14 (36,8)	11 (26,8)	14 (42,4)	46 (32,2)
- acute obstructive bronchitis	11 (35,5)	3 (7,9)	2 (4,9)	2 (6,1)	18 (12,6)
- community-acquired pneumonia	10 (32,2)	15 (39,5)	22 (53,7)	10 (30,3)	57 (39,8)

The distribution of the children examined by classification of their BW, BL and BMI into the percentile ranges according to the current WHO standards [16] is given in Table 3. It should be noted that most of the values of these physical development indicators in all the age subgroups were within the "central" combined range – 15-85% (Table 3).

Table 4 provides the data on the belonging of their 4 integral anthropometric parameters, namely: BW/BL, BW/age, BL/age, and BMI/age, to Z-intervals. This belonging was determined using the "WHO Anthro" software [17]. As with the percentile ranges, Z-scores for all these integral parameters in the children examined from all the age subgroups fell within the middle combined interval – ((-2Z)-(+2Z)).

Beforehand, the chosen categories for the patients' characteristics were coded in all the subgroups, namely: 1) gender, 2) the number of ARI episodes in a previous year (subgroups A and B), 3) the current clinical diagnosis, 4) the percentile range for BW, BL and BMI; 5) the Z-interval for BW/BL, BW/age, BL/age, BMI/age. Subsequent cross-tabulation carried out in the age subgroups between children with less and more frequent ARI episodes, on the one hand, and separately with all the other above-mentioned characteristics, on the other hand, did not demonstrate any interdependence between them in any case.

Rank correlation analysis conducted in all the age subgroups also revealed no association between InI and RI, on the one hand, and the anthropometric indicators studied (BW, BL, CC, BMI, BSA, and Vervek's index), on the other hand. Only a high or very high correlation degree between InI and RI should be noted for the children from all the subgroups. For instance, it was the lowest in subgroup I (ρ=0.880, $p<0.001$, CI: 0.759-0.942), and the highest in subgroup III (ρ=0.974, $p<0.001$, CI: 0.951-0.987).

Using linear regression analysis with stepwise inclusion of independent factors, an attempt was made to identify those that have a significant impact on the considered indices of ARI recurrence. In the children, 7 potential predictors were tested: BW, BL, CC, BMI, BSA, Vervek's index and their age. It was demonstrated that only in subgroup I, when using RI as a dependent variable, the prognostic model with 2 independent factors, specifically the patients' age and their BL, was obtained (Formula). The modelling was unsuccessful for the other age subgroups.

Formula:

$$RI(p) = 1.474^{*} + 0.049^{**} \times \text{age (mos.)} - 0.024^{***} \times \text{BL (cm)},$$

where RI(p) - predicted RI; * - constant B (p=0.028; 95% CI: 0.170-2.778);

** - coefficient b_1 (p=0.001; 95% CI: 0.021-0.077);

*** - coefficient b_2 (p=0.023; 95% CI: (-0.045)-(-0.004)).

According to the mathematical algorithm presented, in children aged 12-23 mos., the predicted RI rises with increasing age and reduces with increasing BL. It should be added that the value of determination coefficient (R^2), taking into account the constant and both predictors, was 0.322. This means that for the children from subgroup I, the influence of these predictors on RI was quite high, accounting for 32.2% among all other possible predictors.

DISCUSSION

Thus, cross-tabulation and rank correlation analysis did not demonstrate any interdependence between the basic indicators of physical development in the

Table 2. Descriptive statistics of basic indicators in the examined children

Indicator	Me	Q_1–Q_3	V_q,%	X_{min}	X_{max}
Subgroup I, n=31					
Age, mos.	18,0	14,0–21,0	19,44	12,0	23,0
BW, kg	11,0	10,0–12,0	9,09	9,0	14,5
BL, cm	80,0	77,0–86,0	5,63	72,0	92,0
CC, cm	50,0	47,5–51,5	4,00	43,0	55,0
BMI, kg/m²	17,19	15,60–19,20	10,47	14,18	21,33
BSA, m²	0,482	0,454–0,522	7,05	0,422	0,566
Vervek's index, RU	1,12	1,07–1,18	4,91	1,01	1,24
InI, RU	0,250	0,167–0,333	33,20	0,056	0,563
RI, RU	0,333	0,250–0,500	37,54	0,083	0,917
Subgroup II, n=38					
Age, mos.	31,5	28,8–34,0	8,25	24,0	35,0
BW, kg	13,0	12,0–15,0	11,54	10,5	17,0
BL, cm	93,0	90,0–96,0	3,23	82,0	102,0
CC, cm	52,0	49,0–54,0	4,81	46,0	57,0
BMI, kg/m²	15,66	14,47–16,39	6,13	13,01	18,14
BSA, m²	0,571	0,544–0,620	6,65	0,476	0,685
Vervek's index, RU	1,18	1,14–1,24	4,24	1,07	1,32
InI, RU	0,169	0,111–0,220	32,25	0,029	0,577
RI, RU	0,417	0,250–0,583	39,93	0,083	1,250
Subgroup III, n=41					
Age, mos.	42,0	37,5–44,0	7,74	36,0	47,0
BW, kg	14,7	13,4–16,0	8,84	11,0	20,0
BL, cm	99,0	96,0–102,0	3,03	92,0	108,0
CC, cm	54,0	52,0–55,0	2,78	48,0	59,0
BMI, kg/m²	14,71	14,15–15,89	5,91	11,53	19,22
BSA, m²	0,626	0,594–0,667	5,83	0,528	0,765
Vervek's index, RU	1,20	1,15–1,25	4,17	1,04	1,38
InI, RU	0,128	0,094–0,156	24,22	0,053	0,256
RI, RU	0,417	0,333–0,583	29,98	0,167	0,917
Subgroup IV, n=33					
Age, mos.	54,0	50,0–56,0	5,56	48,0	59,0
BW, kg	17,0	16,0–19,5	10,29	14,0	22,5
BL, cm	107,0	103,5–112,0	3,97	95,0	119,0
CC, cm	56,0	54,0–57,6	3,21	50,0	67,0
BMI, kg/m²	15,42	14,65–16,49	5,97	10,77	18,69
BSA, m²	0,702	0,679–0,771	6,55	0,617	0,863
Vervek's index, RU	1,17	1,13–1,22	3,85	1,06	1,32
InI, RU	0,111	0,081–0,147	29,73	0,018	0,260
RI, RU	0,500	0,333–0,667	33,40	0,083	1,083

Note: RU - relative unit

different age subgroups of the children aged 12-59 mos. and their susceptibility to RRI. On the one hand, this is in line with the data from Pieniawska-Śmiech et al. according to which BW, BL and BMI in the patients aged 4 weeks to 18 years with RRI did not differ from the same indicators in the control subjects who did not have any history of frequent ARI episodes [18]. On the other hand, there are the current scientific publications that confirm

Table 3. Distribution of the examined children by their BW, BL and BMI belonging to percentile ranges

Percentile range*	Anthropometric indicator		
	BW, n (%)	BL, n (%)	BMI, n (%)
Subgroup I, n=31			
1-3%	-	1 (3,2)	-
3-5%	-	1 (3,2)	-
5-15%	-	7 (22,6)	1 (3,2)
15-25%	2 (6,4)	1 (3,2)	2 (6,5)
25-50%	5 (16,1)	3 (9,7)	4 (12,9)
50-75%	8 (25,8)	7 (22,6)	9 (29,0)
75-85%	6 (19,4)	4 (12,9)	1 (3,2)
85-95%	6 (19,4)	3 (9,7)	4 (12,9)
95-97%	1 (3,2)	1 (3,2)	2 (6,5)
97-99%	3 (9,7)	3 (9,7)	4 (12,9)
higher 99%	-	-	4 (12,9)
Subgroup II, n=38			
1-3%	-	-	1 (2,6)
3-5%	-	1 (2,6)	2 (5,3)
5-15%	5 (13,2)	3 (7,9)	6 (15,8)
15-25%	1 (2,6)	2 (5,3)	2 (5,3)
25-50%	8 (21,1)	9 (23,7)	8 (21,0)
50-75%	13 (34,2)	9 (23,7)	10 (26,3)
75-85%	3 (7,9)	3 (7,9)	3 (7,9)
85-95%	7 (18,4)	6 (15,8)	5 (13,2)
95-97%	1 (2,6)	1 (2,6)	1 (2,6)
97-99%	-	4 (10,5)	-
Subgroup III, n=41			
lower 1%	-	-	1 (2,4)
1-3%	1 (2,4)	-	3 (7,3)
5-15%	5 (12,2)	5 (12,2)	4 (9,8)
15-25%	4 (9,8)	5 (12,2)	8 (19,6)
25-50%	14 (34,2)	9 (21,9)	10 (24,4)
50-75%	8 (19,5)	9 (21,9)	7 (17,1)
75-85%	5 (12,2)	4 (9,8)	3 (7,3)
85-95%	1 (2,4)	6 (14,7)	3 (7,3)
95-97%	3 (7,3)	-	-
97-99%	-	3 (7,3)	1 (2,4)
higher 99%	-	-	1 (2,4)
Subgroup IV, n=33			
lower 1%	-	-	1 (3,0)
1-3%	1 (3,0)	1 (3,0)	-
3-5%	-	1 (3,0)	-
5-15%	3 (9,1)	3 (9,1)	1 (3,0)
15-25%	-	3 (9,1)	4 (12,1)
25-50%	9 (27,3)	7 (21,2)	8 (24,2)
50-75%	8 (24,2)	5 (15,2)	9 (27,3)
75-85%	4 (12,1)	5 (15,2)	5 (15,2)
85-95%	6 (18,2)	2 (6,1)	3 (9,1)
95-97%	2 (6,1)	2 (6,1)	-
97-99%	-	4 (12,0)	2 (6,1)

Note: * - only the percentile ranges including at least one indicator were shown.

Table 4. Distribution of the examined children by their integral anthropometric parameters belonging to Z-intervals

Z-interval*	Integral anthropometric parameter			
	BW/BL, n (%)	BW/age, n (%)	BL/age, n (%)	BMI/age, n (%)
Subgroup I, n=31				
(-3)-(-2) Z	-	-	1 (3,2)	-
(-2)-(-1) Z	1 (3,2)	-	8 (25,8)	1 (3,2)
(-1)-0 Z	10 (32,3)	6 (19,4)	5 (16,1)	6 (19,3)
0-(+1) Z	6 (19,4)	15 (48,4)	10 (32,3)	10 (32,3)
(+1)-(+2) Z	9 (29,0)	9 (29,0)	5 (16,1)	10 (32,3)
(+2)-(+3) Z	5 (16,1)	1 (3,2)	2 (6,5)	3 (9,7)
↑(+3) Z	-	-	-	1 (3,2)
Subgroup II, n=38				
(-3)-(-2) Z	-	-	-	1 (2,6)
(-2)-(-1) Z	8 (21,1)	5 (13,2)	4 (10,5)	8 (21,1)
(-1)-0 Z	11 (28,9)	10 (26,3)	11 (28,9)	11 (28,9)
0-(+1) Z	13 (34,2)	15 (39,5)	12 (31,6)	12 (31,6)
(+1)-(+2) Z	6 (15,8)	8 (21,0)	8 (21,1)	6 (15,8)
(+2)-(+3) Z	-	-	3 (7,9)	-
Subgroup III, n=41				
↑(-3) Z	1 (2,4)	-	-	1 (2,4)
(-3)-(-2) Z	2 (4,9)	-	-	3 (7,3)
(-2)-(-1) Z	5 (12,2)	8 (19,5)	5 (12,2)	6 (14,6)
(-1)-0 Z	17 (41,5)	17 (41,5)	14 (34,1)	16 (39,0)
0-(+1) Z	10 (24,4)	12 (29,2)	13 (31,7)	9 (22,0)
(+1)-(+2) Z	5 (12,2)	4 (9,8)	6 (14,7)	4 (9,8)
(+2)-(+3) Z	1 (2,4)	-	3 (7,3)	2 (4,9)
Subgroup IV, n=33				
↑(-3) Z	1 (3,0)	-	-	1 (3,0)
(-3)-(-2) Z	-	-	1 (3,1)	-
(-2)-(-1) Z	2 (6,1)	4 (12,1)	4 (12,1)	1 (3,0)
(-1)-0 Z	11 (33,3)	9 (27,3)	10 (30,3)	12 (36,4)
0-(+1) Z	14 (42,4)	12 (36,4)	10 (30,3)	13 (39,4)
(+1)-(+2) Z	4 (12,2)	8 (24,2)	4 (12,1)	5 (15,2)
(+2)-(+3) Z	1 (3,0)	-	4 (12,1)	1 (3,0)

Note: * - only the Z-intervals including at least one parameter were shown.

the higher susceptibility of children to RRI if they have substantial deviations in anthropometric indicators [13,14]. It should also be taken into consideration that in all the age subgroups, the total number of children with physical development indicators belonging to the extreme percentile ranges and Z-intervals was relatively small. This could be the main reason for the ineffectiveness of the above-mentioned correlation analyses. Nevertheless, linear regression analysis performed in the children aged 12-23 mos. was effective, demonstrating the dependence of RI on their age and BL. This suggests planning and conducting further studies on the relationship between anthropometric indicators and the frequency of ARI episodes in preschool children.

Several limitations of the study should be acknowledged. First, the study involved only those children who were undergoing hospital treatment, and outpatients were not included. Second, there are still some doubts about the accuracy of anamnestic data on the frequency of ARI episodes taken into account. Third, the number of subjects in the age subgroups was relatively small. Fourth, the informativeness regarding the impact of anthropometric indicators on children's susceptibility to RRI may be reduced, as the simultaneous combined effect of many known RRI risk factors [10-12] was not considered. Finally, the findings probably cannot be entirely extrapolated to all children of the same age from different countries due to certain differences in the physical development of child's body, which are determined by geographical or even regional lifestyle conditions.

CONCLUSIONS

In the children aged 12-59 mos., cross-tabulation and rank correlation analysis showed no association between their susceptibility to recurrent respiratory infections and anthropometric indicators. At the same time, among the children aged 12-23 mos., linear regression analysis revealed significant dependence of resistance index on their age and body length. The methodological grounds for further studies of the relationship between preschoolers' susceptibility to frequent acute respiratory infections and the state of their physical development were outlined.

REFERENCES

1. Cardinale F, La Torre F, Tricarico LG et al. Why do some children get sick with recurrent respiratory infections?. Curr Pediatr Rev. 2024;20(3):203–215. doi: 10.2174/1573396320666230912103056. DOI
2. El-Koofy NM, El-Shabrawi MH, Abd El-Alim BA et al. Patterns of respiratory tract infections in children under 5 years of age in a low-middle-income country. J Egypt Public Health Assoc. 2022;97(1):22. doi: 10.1186/s42506-022-00118-0. DOI
3. Etrhuni S, Omar R, Hadid I. Risk factors of acute respiratory infections in children in Tripoli, Libya. Ibnosina J Med Biomed Sci. 2020;12(3):200–207. doi: 10.4103/ijmbs.ijmbs_77_20. DOI
4. Khan Laghari I, Nawaz T, Mustafa S et al. Role of multi-strain probiotics in preventing severity and frequency of recurrent respiratory tract infections in children. BMC pediatr. 2023;23(1):505. doi: 10.1186/s12887-023-04338-x. DOI
5. Jaybhaye AP, Sangle AL, Ugra D et al. A Hospital-Based Study of Vitamin D Levels in Children With Recurrent Respiratory Infections. Cureus. 2022;14(8):e27864. doi: 10.7759/cureus.27864. DOI
6. Vezhnovets EI, Yashchenko YB, Gurianov VG. National assessment of pneumonia morbidity in children in the period 1993-2017 and prognosis for 2025. Wiad Lek. 2022;75(5):1175–1179. doi: 10.36740/wlek202205122. DOI
7. Chiappini E, Santamaria F, Marseglia GL et al. Prevention of recurrent respiratory infections. Ital. J. Pediatr. 2021;47:211. doi: 10.1186/s13052-021-01150-0. DOI
8. Nagaraju K, Shah R, Ganapathy S et al. Practical Approach for the Diagnosis, Prevention, and Management of Recurrent Upper Respiratory Tract Infection in Children: Report from an Expert Closed-group Discussion. Pediatr Inf Dis. 2021;3:105–112. doi: 10.5005/jp-journals-10081-1321. DOI
9. Pasternak G, Lewandowicz-Uszyńska A, Królak-Olejnik B. Nawracające zakażenia dróg oddechowych u dzieci [Recurrent respiratory tract infections in children]. Pol Merkur Lekarski. 2020;49(286):260–266. (Polish).
10. Ameli F, Brocchetti F, Mignosi S et al. Recurrent respiratory infections in children: a study in clinical practice. Acta Biomed. 2020;91(4):e2020179. doi: 10.23750/abm.v91i4.8585. DOI
11. Voloshin OM, Marushko YuV, Savchenko II et al. Simeini faktory ryzyku rekurentnoho perebihu hostrykh respiratornykh infektsii u ditei vikom 2-5 rokiv [Family risk factors in the recurrent course of acute respiratory infections in children aged 2-5 years]. Suchasna pediatriya. Ukrayina. 2023;7:23–32. doi: 10.15574/SP.2023.135.23. (Ukrainian). DOI
12. Zhou B, Niu W, Liu F et al. Risk factors for recurrent respiratory tract infection in preschool-aged children. Pediatr. Res. 2021;90:223–231. doi: 10.1038/s41390-020-01233-4. DOI
13. Adila NT. The Correlation Between Acute Respiratory Infections and Incidence of Stunting. JIKSH. 2021;10(1):273–279. doi: 10.35816/jiskh.v10i1.605. DOI
14. Arias-Bravo G, Valderrama G, Inostroza J et al. Overnutrition in Infants Is Associated With High Level of Leptin, Viral Coinfection and Increased Severity of Respiratory Infections: A Cross-Sectional Study. Front. Pediatr. 2020;8:44. doi: 10.3389/fped.2020.00044. DOI
15. Halvorson EE, Peters TR, Skelton JA et al. Is weight associated with severity of acute respiratory illness? IJO. 2018;42(9):1582–1589. doi: 10.1038/s41366-018-0044-y. DOI
16. World Health Organization. Child growth standards. 2024. https://www.who.int/tools/child-growth-standards/standards [Accessed 11 February 2024].
17. World Health Organization. Child growth standards. 2024. https://www.who.int/tools/child-growth-standards/software [Accessed 07 February 2024].
18. Pieniawska-Śmiech K, Bar K, Babicki M et al. Assessment of weight and height of patients with primary immunodeficiency disorders and group of children with recurrent respiratory tract infections. BMC Immunol. 2020;21(1):42. doi: 10.1186/s12865-020-00372-x. DOI

The study was conducted within the framework of the initiative research work of the Department of Pediatrics with Childhood Infections of State institution "Luhansk State Medical University" (Rubizhne, Ukraine) "Current aspects of *the influence of perinatal factors on the development of somatic pathology in children aged 1-14 years" (2017-2021, № state registration 0117U003041). No external funding was received for this study.*

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR
Oleksandr M. Voloshyn
Luhansk State Medical University
36 16th July St, 33028 Rivne, Ukraine
e-mail: ditlikar@ukr.net

ORCID AND CONTRIBUTIONSHIP
Oleksandr M. Voloshyn: 0000-0001-7612-6521 A B C D
Yurii V. Marushko: 0000-0001-8066-9369 F
Tetiana V. Hyshchak: 0000-0002-7920-7914 E
Iryna I. Savchenko: 0000-0003-0820-2152 B

A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

RECEIVED: 26.11.2023
ACCEPTED: 18.03.2024