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ORIGINAL ARTICLE

Comparative assessment of cardiorespiratory function and physical fitness in students with chronic respiratory diseases versus healthy students

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ABSTRACT

This study aimed to evaluate the functional performance of the cardiovascular and respiratory systems, as well as the physical fitness levels, of students aged 14–17 years with chronic respiratory diseases compared to their healthy peers. Methods: A mixed-methods approach was employed, including analysis of scientific literature, pedagogical observation, and functional assessments. A pedagogical experiment was conducted at two secondary schools in Mostaganem, Algeria, involving 26 students with chronic respiratory conditions (17 boys, 9 girls) and 25 healthy peers (18 boys, 7 girls). Key indicators such as systolic and diastolic blood pressure, heart rate, vital lung capacity, and results from the Stange and Henchi tests were measured. Physical fitness was assessed through a 30-meter sprint, medicine ball throws, pull-ups, and flexibility tests. Results: Significant differences were observed between the two groups. Students with chronic respiratory diseases exhibited higher diastolic blood pressure ($p < .05$) and elevated heart rates at rest, post-exercise, and during recovery, indicating reduced cardiovascular adaptability. Respiratory function tests revealed substantial age lags (Stange: 21.7% in boys, 21.0% in girls; Henchi: 47.5% in boys, 39.7% in girls). Vital lung capacity was significantly lower (43.7% lag in boys, 51.8% in girls). Physical fitness tests demonstrated notable deficits in speed, strength, and flexibility, with significant differences ($p < .05$) across all metrics. Discussion: The findings highlight the profound impact of chronic respiratory diseases on cardiovascular and respiratory function, as well as physical fitness, in students. These results underscore the need for personalised physical education programs and healthcare interventions to address these differences. Implementing inclusive strategies and targeted support can enhance the quality of life and long-term health outcomes for students with chronic respiratory conditions.

Keywords: Sport medicine, Cardiovascular, Respiratory, Students, Physical fitness, Diseases.

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INTRODUCTION

Over the past few years, scientists have identified a negative trend that shows that the level of diseases directly related to the respiratory system has increased significantly among preschool and school-age children (Zhu, Yuan, & Yang, 2024). These diseases are accompanied by a decrease in indicators of the age level of physical development and motor defects (Maggio et al., 2010; Adel et al., 2019). According to earlier studies, currently general educational organisations teach on a permanent basis children with a normal level of health not more than 15%, and with pathological manifestations of a chronic nature - more than 30% (Coe, Peterson, Blair, Schutten, & Peddie, 2013; Soldatov et al., 2024). Scientists who have devoted their research to studying the health of school and pre-school children have found that the implementation of the modern educational process has a direct connection with the very specifics of learning; in addition, one third of children, when they move from pre-school to first grade, already have chronic diseases (Levick, 1991; Lee et al., 2012; Meijer et al., 2021).

National education organisations of the Republic of Algeria, when reporting on the state of disease to higher institutions, indicate figures indicating that the number of school-age children classified in special medical groups tends to increase progressively (Khelafi, Aissanou, Tarsift, & Skander, 2011; Kuchma et al., 2017). A large proportion of children suffer from chronic respiratory diseases, mostly in the age range of school students aged 14-16, of whom 73% were boys and 27% girls. Taking into account this situation, it can be stated that the therapeutic and health-improving orientation of specially organised therapeutic physical education classes in the conditions of national education institutions is of global importance (Carnethon et al., 2003; Latorre-Román, Navarro-Martínez, & García-Pinillos, 2014; Abdelkader et al., 2021).

The data obtained by scientists in the process of experimental research have allowed to determine that students with chronic respiratory diseases have increased lags in the development of motor abilities (Krivolapchuk, Chernova, & Gerasimova, 2020; Raghuveer et al., 2020). Therefore, the solution of the problem lies in the need to orient the means of therapeutic physical training not only to eliminate and compensate for pathological manifestations in the respiratory organs, but also to improve the motor fitness of students of all age categories (Kuzmin et al., 2016; Krivolapchuk et al., 2020; Lytvynenko & Prontenko, 2020; Moawd, Azab, Ibrahim, Verma, & Abdelbasset, 2020).

According to the 2008 US report on national exercise and the 2010 World Health Organisation report, for the general adult population For the average adult, aerobic exercise with a moderate intensity of 150 minutes or more or vigorous intensity of 75 minutes or more per week is recommended (Carlson, Fulton, Schoenborn, & Loustalot, 2010; Beard et al., 2016; Singh, Pattisapu, & Emery, 2020; Belkadi, Alia, & Mohammed, 2020).

According to the American College of Sports Medicine (ACSM) According to the position statement of the American College of Sport Medicine (ACSM) in 2010, cardiorespiratory fitness is one of the most common forms of exercise, the better the cardiorespiratory fitness, the lower the risk of becoming unhealthy; and among the body composition issues, overall or abdominal obesity is the most common cause of obesity (Millar, Fernhall, & Burkett, 1993; Garber et al., 2011; Beboucha, Belkadi, Benchehida, & Bengoua, 2021).

Therefore, it is recommended that adults engage in moderate-intensity cardiorespiratory training for more than 30 minutes at least 5 days a week (minimum 150 minutes per week), and high-intensity cardiorespiratory training for at least 30 minutes per week (minimum 150 minutes per week), High-intensity cardiorespiratory exercise should be more than 20 minutes per session (at least 75 minutes per week) on at least 3 days per

week, or a combination of moderate- and high-intensity cardiorespiratory exercise (Belkadi et al., 2015; Yang, 2019).

The aim of this paper is to evaluate and compare the functional performance of the cardiovascular and respiratory systems, as well as the physical fitness levels, of students aged 14–17 years with chronic respiratory diseases against their healthy peers. the research aims to highlight the impact of chronic respiratory conditions on overall health and physical development, ultimately advocating for the implementation of personalised physical education programs and healthcare interventions to improve the quality of life and long-term health outcomes for affected students.

METHODS AND MATERIALS

Participants

A mixed-methods approach was employed, combining the analysis of scientific literature, pedagogical observation, and functional assessments. The study was conducted in two secondary schools located in Mostaganem, Algeria, involving a total of 51 students aged 14–17 years. Participants were divided into two groups:
Group 1: Students with chronic respiratory diseases (SRD), consisting of 26 individuals (17 boys and 9 girls).
Group 2: Healthy students (HS), consisting of 25 individuals (18 boys and 7 girls).

The pedagogical experiment was implemented within an inclusive educational framework at two secondary education institutions in Mostaganem city. Special medical groups were created for students with health deviations, including those with chronic respiratory diseases, to facilitate tailored assessments and interventions.

Study design

The study design focused on evaluating and comparing the activity of the respiratory and cardiovascular systems, as well as physical fitness levels, between students aged 14–17 years with chronic respiratory diseases and their healthy peers, involving 26 students with chronic conditions (17 boys, 9 girls) and 25 healthy students (18 boys, 7 girls). Adhering to the principles of inclusive education and ethical guidelines (World Medical Association, 2013), the study integrated participants into regular educational processes while providing specialized assessments. Key cardiorespiratory indicators, including systolic and diastolic blood pressure, heart rate, vital lung capacity, and respiratory function (assessed via the Stange and Henchi tests), were measured alongside physical fitness tests such as a 30-meter sprint (speed), medicine ball throws (upper body power), pull-ups or lying pull-ups (muscular endurance), and a forward bend (flexibility). These standardised protocols allowed for a comprehensive comparison, highlighting the impact of chronic respiratory diseases on functional performance and informing the need for tailored interventions to address observed disparities.

Statistical analyses

Descriptive statistics, including means, standard deviations, and frequencies, were calculated to summarize the demographic, cardiorespiratory, and physical fitness characteristics of the study participants. The normality of the data distribution was assessed using the Shapiro-Wilk test. All statistical analyses were performed using SPSS version 27 (IBM Corp., Armonk, NY, USA), and a p-value of $< .05$ was considered statistically significant.

RESULTS

The analysis of the state and activity of the cardiovascular and respiratory systems fulfils the task of fully characterising their functional performance. On the basis of individual information indicators the form of heart, systolic and diastolic blood pressure, heart, vital capacity of lungs, Stange and Henchy tests, tests it is possible to determine not only the level of their state, but also the dynamics of the ongoing age-related changes. Based on the work of (Wittberg, Northrup, & Cottrell, 2012), the above-mentioned studies were carried out on students 14-17 years old with chronic respiratory diseases and their peers without these pathological manifestations. The tables present the obtained indicators of the studied contingent with gender differences (Tables 1, 2, 3 and 4), and a comparative analysis of the results obtained.

Table 1. Analysis of systolic (SD) and diastolic (DD) blood pressure (BP) indices (boys and girls) 14-17 years old.

Indicators			**Boys (Mean ± SD)**			
			14 years	15 years	16 years	17 years
Blood pressure	SD	SRD	101.7 ± 6.7	106.8 ± 6.0	112.3 ± 11.0	108.1 ± 9.3
		HS	101.5 ± 4.1	105.3 ± 4.9	107.9 ± 5.6	106.2 ± 7.1
	DD	SRD	61.1 ± 10.1*	62.3 ± 4.5 *	60.5 ± 5.8*	62.0 ± 10.6*
		HS	54.4 ± 3.3	55.5 ± 3.0	55.1 ± 2.8	56.0 ± 4.1
Indicators			**Girls (Mean ± SD)**			
			14 years	15 years	16 years	17 years
Blood pressure	SD	SRD	103.7 ± 3.1	98.0 ± 5.8	104.4 ± 11.2	109.8 ± 8.9
		HS	97.8 ± 5.8	96.8 ± 3.0	101.5 ± 4.8	106.4 ± 5.2
	DD	SRD	58.6 ± 5.9	53.2 ± 7.4	55.9 ± 9.3	59.8 ± 5.9
		HS	52.4 ± 2.2	51.9 ± 2.2	52.8 ± 2.5	58.7 ± 2.6

*Note: SRD - indicators of students with respiratory diseases; SH - indicators of healthy students; * - reliability of differences at p < .05.*

Table 2. Heart rate Analysis before, after exercise (boys and girls) 14-17 years old.

Indicators		**Boys (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Heart rate before exercise, in 1min.	SRD	80.1 ± 1.9 *	80.3 ± 2.7	79.8 ± 2.4 *	80.0 ± 2.4
	SH	75.0 ± 6.9	77.4 ± 5.0	77.9 ± 2.7	77.4 ± 4.2
Heart rate after exercise, in 1 min.	SRD	125.4 ± 4.0 *	128.5 ± 8.1	123.8 ± 8.1	124.6 ± 5.6 *
	SH	119.4 ± 7.2	121.7 ± 7.5	120.2 ± 5.6	117.8 ± 3.7
Heart rate after min. recovery	SRD	91.3 ± 3.3 *	92.0 ± 3.7 *	86.4 ± 2.6 *	89.4 ± 3.8 *
	SH	83.6 ± 6.3	85.3 ± 5.7	82.6 ± 2.3	82.6 ± 4.6
Indicators		**Girls (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Heart rate before exercise, in 1min.	SRD	84.3 ± 13.0	81.3 ± 4.3	75.8 ± 7.1	80.3 ± 2.7
	SH	75.2 ± 5.3	80.0 ± 4.8	73.2 ± 3.0	76.7 ± 5.0
Heart rate after exercise, in 1 min.	SRD	132.9 ± 8.0 *	125.0 ± 3.7	121.0 ± 5.7	122.7 ± 6.8
	SH	122.3 ± 8.2	121.6 ± 5.1	116.3 ± 4.3	119.6 ± 7.1
Heart rate after 1 min. recovery	SRD	107.1 ± 12.6 *	95.3 ± 5.3	89.5 ± 7.2 *	89.3 ± 4.5
	SH	85.3 ± 5.3	89.0 ± 4.8	81.6 ± 3.6	85.2 ± 3.6

*Note: SRD - indicators of students with respiratory diseases; SH - indicators of healthy students; * - reliability of differences at p < .05.*

In the (Table 1) the analysis of systolic (SD) and diastolic (DD) blood pressure (BP) indices revealed the following differences: the level of systolic BP in both groups under study has no significant differences, the differences are reliable ($p > .05$); diastolic BP in students without chronic diseases is at a lower level with

reliable differences ($p < .05$) than in students with chronic respiratory diseases. However, these differences are not significant in the age range we studied.

Analytical comparison of the heart rate (HR) at rest in sitting position, immediately after physical exercise and after 1 minute of recovery rest revealed that students with chronic respiratory diseases have lower than healthy peers (Table 2). That is, the heart rate to be measured at all these stages is numerically higher than in the latter, indicating a lower level of adaptation of the cardiovascular system to physical exertion in students with respiratory pathology with the reliability of differences ($p < .05$).

The results obtained in the performed tests revealed the following qualitative differences: in students without respiratory diseases the level of tests corresponds to age norms, in students with respiratory system pathology; and the results of the considered functional tests are significantly lower. Thus, in the Stang test in boys the index in the age lag by 21.7 per cent, in girls - by 21.0 per cent. The Henchi test revealed a higher level of differences in the indicators: the age lag in boys corresponds to 47.5%, in girls - 39.7%. The significance of differences corresponds to $p < .05$. After statistical processing of the obtained data in (Table3), we performed a comparative assessment of physical performance using the Ruffier index (Table.3). In the process of comparison, it was revealed that students belonging to special medical group have a lower level of this informative unit than their healthy peers.

Table 3. Stange and Henchi tests, Ruffier Index (boys and girls) 14-17 years old.

Tests		**Boys (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Respiratory rate per 1 min.	SRD	19.0 ± 1.5 *	16.4 ± 6.0	19.0 ± 1.2 *	19.1 ± 2.9 *
	SH	16.3 ± 1.9	15.5 ± 1.4	16.4 ± 1.5	16.0 ± 1.4
Stange's test.	SRD	46.4 ± 8.4 *	51.1 ± 9.8 *	51.0 ± 9.1 *	57.4 ± 6.5 *
	SH	59.6 ± 5.0	63.5 ± 5.5	62.1 ± 6.0	65.5 ± 4.1
Hench's test	SRD	27.0 ± 9.5 *	27.8 ± 10.5 *	29.4 ± 12.5 *	39.6 ± 7.8 *
	SH	38.5 ± 11.9	45.6 ± 8.9	44.9 ± 10.5	53.7 ± 7.0
Ruffier Index	SRD	9.7 ± 0.7 *	10.1 ± 1.3 *	9.0 ± 1.0	9.4 ± 1.1 *
	SH	7.8 ± 1.8	8.5 ± 1.7	8.1 ± 0.9	7.8 ± 1.0
Tests		**Girls (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Respiratory rate per 1 min.	SRD	19.7 ± 3.3 *	19.2 ± 1.3 *	17.4 ± 1.9	18.3 ± 1.2
	SH	16.0 ± 1.7	16.4 ± 1.5	16.0 ± 1.8	16.2 ± 1.4
Stange's test.	SRD	35.6 ± 6.0 *	43.0 ± 10.8 *	48.3 ± 8.1 *	50.3 ± 6.1 *
	SH	46.7 ± 6.7	54.5 ± 6.0	55.9 ± 6.6	57.4 ± 7.2
Hench's test	SRD	22.4 ± 5.0 *	26.5 ± 6.1 *	29.4 ± 10.4 *	29.7 ± 3.6 *
	SH	29.9 ± 4.9	38.1 ± 9.1	42.8 ± 12.0	41.2 ± 10.7
Ruffier Index	SRD	5.2 ± 1.6 *	10.2 ± 1.1	8.6 ± 1.7 *	9.2 ± 1.3
	SH	8.3 ± 1.7	9.1 ± 0.9	7.1 ± 0.8	8.2 ± 1.5

*Note: SRD - indicators of students with respiratory diseases; SH - indicators of healthy students; * - reliability of differences at p < .05.*

The age-related indicators of the cardiorespiratory system's functional state in students aged 14–17 years align with earlier findings reported by (Lee et al., 2012; Soldatov et al., 2024; Wittberg et al., 2012). According to the author's evaluation (Table 4), students without health deviations demonstrated cardiovascular and respiratory system activity levels categorized as "*above average*," whereas those with respiratory pathologies fell within the "*low level*" range. Significant differences were observed in most parameters for boys, with

statistical reliability ($p < .05$). However, in girls, the reliability of differences for some indicators did not reach statistical significance.

Table 4. Level of cardiovascular and respiratory system (boys and girls) 14-17 years old.

Parameters		**Boys (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Chest circumference, cm.	SRD	55.8 ± 12.9	54.9 ± 4.6	68.1 ± 5.2	79.2 ± 11.5
	SH	60.6 ± 7.7	60.6 ± 7.6	76.0 ± 10.3	78.9 ± 18.7
Vital capacity of the lungs, l. ml.	SRD	2.0 ± 1.0 *	1.9 ± 0.4 *	2.2 ± 0.3 *	2.5 ± 0.3 *
	SH	2.7 ± 0.5	3.0 ± 0.6	3.3 ± 0.5	3.5 ± 0.6
Functional state	SRD	0.6 ± 0.1 *	0.6 ± 0.0 *	0.6 ± 0.0 *	0.6 ± 0.0 *
	SH	0.7 ± 0.1	0.7 ± 0.0	0.6 ± 0.0	0.6 ± 0.0
Tests		**Girls (Mean ± SD)**			
		14 years	15 years	16 years	17 years
Chest circumference, cm	SRD	58.9 ± 4.4	67.0 ± 8.4	67.0 ± 4.3	67.1 ± 6.8
	SH	60.2 ± 11.4	65.3 ± 7.0	72.1 ± 10.3	68.1 ± 10.5
Vital capacity of the lungs, lit. ml.	SRD	1.3 ± 0.3 *	1.3 ± 0.3 *	1.8 ± 0.4 *	1.9 ± 0.6 *
	SH	2.2 ± 0.3	2.4 ± 0.6	2.7 ± 0.4	2.9 ± 0.3
Functional state	SRD	0.8 ± 0.5*	0.6 ± 0.0	0.7 ± 0.1	0.6 ± 0.1
	SH	0.7 ± 0.0	0.6 ± 0.0	0.7 ± 0.0	0.6 ± 0.1

*Note: SRD - indicators of students with respiratory diseases; SH - indicators of healthy students; * - reliability of differences at p < .05.*

For a complete analytical characterisation of students with chronic respiratory diseases, a test was implemented to determine the factor indicators indicating the level of physical development, In order to determine the negative impact of the underlying disease on student's motor skills.

Table 5. Indicators reflecting the level of development of motor abilities of 14–17-year-old students.

Indicators		**(Mean ± SD)**			
		14-15 years old		16-17 years old	
		Boys	Girls	Boys	Girls
Running 30 m from a high start	SRD	4.9 ± 0.6 *	5.0 ± 1.1	4.7 ± 1.2 *	4.8 ± 0.4 *
	SH	4.3 ± 0.4	4.4 ± 0.3	4.1 ± 0.6	4.3 ± 1.0
Throwing a stuffed ball	SRD	397.5 ± 0.4 *	377.0 ± 0.3 *	414.3 ± 1.3 *	411.5 ± 11.0 *
	SH	421.9 ± 12.7	402.5 ± 10.4	441.3 ± 12.1	437.2 ± 11.7
Dead hang pull-ups and lying pull-ups	SRD	2.5 ± 1.1 *	6.5 ± 1.0 *	2.4 ± 1.0 *	7.6 ± 1.8 *
	SH	4.2 ± 1.3	10.9 ± 1.2	4.0 ± 1.3	13.0 ± 1.1
Forward bend from a standing position	SRD	- 5.3 ±2.3 *	4.1 ± 3.1 *	-6.1 ± 1.7 *	3.6 ± 1.9 *
	SH	2.1 ± 1.9	7.2 ± 4.4	3.9 ± 2.0	5.9 ± 2.4

*Note: 1 - indicators of students with chronic respiratory diseases; 2 - indicators of healthy students; * - reliability of differences p < .05.*

The obtained indicators were systematised and underwent statistical processing, the results of which revealed that in all areas of testing in both study groups the results were similar to the indicators of the functional state of the cardiovascular and respiratory systems. Thus, in the test "*Running 30 metres from a high start*" it was determined that the level of speed development in students with no health deviations is higher than in peers with respiratory pathology, with reliability of differences $p < .05$. In the latter, at the age of 14-15 years, the lag in the development of this ability is: in boys - 13.9%, in girls - 13.6%; at the age of 16-17 years, in boys - 14.0%, in girls - 11.0%.

In the test "*Throwing a stuffed ball 2 kg*" in students of 14-15 years old with respiratory diseases the age lag was revealed: in boys - by 6.2%, in girls - by 6.6%; in students of 16-17 years old the lag from healthy peers is: in boys - 6.5%, in girls - 6.3%. Reliability of differences in obtained indicators is $p < .05$.

The indicators of the test "*Pull-up in hanging on the high bar*" in boys and "*Pull-up in hanging lying on the low bar*" in girls allowed to reveal a lag in the development of strength in students with respiratory pathology in the age group of 14-15 years: in boys on 42.5 per cent, for girls - by 69.2 per cent. In the age group of 16-17 years old, the lag in boys is 61.2 per cent, in girls - 71.0 per cent. The significance of differences between the indicators was $p < .05$.

In the test "*Forward bend from a standing position on a gymnastic bench*" in the process of testing in both studied age groups of boys referred to the special medical group, the indicators turned out to have a minus value. The age lag from healthy peers in the development of the ability "*flexibility*" in students of 14-15 years old with respiratory diseases was revealed: in boys - by 116.3%, in girls - by 75.0%. In the age group of 16-17 years old, the former lagged behind by 87.7%, the latter - by 52.7%.

DISCUSSION

The analysis of the functional capabilities of the cardiovascular and respiratory systems of students within the range of 14-17 years of age, both suffering from or free from respiratory chronic diseases, reveals some physiological and developmental differences between both these groups. These findings prove to note significant differences in the principal health information standard, physical performance characteristics, and adaptation to the incorporated measures of physical strain of paramount importance in assessing the extent of general health demand based on the chronic-respiratory-conditions-versus-motor-skills hypothesis (Carnethon et al., 2003; Carlson et al., 2010; Kuzmin et al., 2016). Cardiovascular System Performance It was found that, while the mean systolic blood pressure (SBP) was statistically comparable in students with chronic respiratory diseases and students without such pathologies similar to (Mahishale & Kulkarni, 2014), significant differences were found to occur based on the mean diastolic blood pressure (DBP): about 12 mm of Hg were higher in students with chronic respiratory diseases (Meijer et al., 2021; Belkadi et al., 2025). This could imply that the cardiovascular system of students with respiratory pathologies encounters increased resistance in the peripheral vascular beds, possibly because reduced availability of oxygen cascaded into chronic inflammation (Boudehri, Belkadi, Dahoune, & Atallah, 2023; Rimdeikienė, 2023). The heart rate (HR) recordings during rest, post-exercise, and in the recovery, stage again turned out to be above values when comparing respective reading in students with respiratory diseases (Latorre-Román et al., 2014; Kuchma et al., 2017; Moawd et al., 2020; Cherara, Belkadi, Mesaliti, & Beboucha, 2022). It thus points toward decreased capacity of the cardiovascular system of these students to cope with physical stress (Lee et al., 2012; Manar, Adel, Lalia, & Saddak, 2023). These findings are in line with the literature that chronic respiratory conditions can induce a decline in cardiovascular performance and recovery (Levick, 1991; Maggio et al., 2010; Coe et al., 2013; Soldatov et al., 2024; Zhu et al., 2024).

The results of the Stange and Henchi tests and measurements of vital lung capacity (VLC) showed that the respiratory capacities of students with chronic respiratory diseases were profoundly impaired (LUGININA, 1960; Latorre-Román et al., 2014). The lag in age equivalence test results (21.7% in boys and 21.0% in girls for the Stange test and 47.5% in boys and 39.7% in girls for the Henchi test), further indicates the great impact of respiratory pathologies on lung function (Lytvynenko & Prontenko, 2020). The lower VLC observed in these students corresponds to a 43.7% lag in The age lag in the test results (21.7% in boys and 21.0% in girls for the Stange test, and 47.5% in boys and 39.7% in girls for the Henchi test) this was pointed to the

extensive influence respiratory pathologies place on lung function (Moawd et al., 2020). Besides, the diminished VLC (43.7% in boys and 51.8% in girls) reinforces an already co-performance of the Respiratory System (Сарыг, Куулар, & Ондар, 2021; Benhammou, Mourot, Mokkedes, Bengoua, & Belkadi, 2021).

According to Stange and Henchi tests, and the vital lung capacity (VLC) measuring, there is a significant respiratory compromise in school students suffering from chronic respiratory conditions (Chen et al., 2011; Yacine et al., 2020). The 21.7% and 21.0% lag of boys and girls, respectively, in Stange test, and 47.5% and 39.7% lag in boys and girls, respectively, highlights that these respiratory pathologies have a great bearing on the lung functions. The reduced lung capacity observed in these students (43.7% in boys and 51.8% in girls) further underscores the impaired respiratory function in this population (Mihailova & Kaminska, 2016). This diminished respiratory capacity likely contributes to the observed declines in physical abilities and endurance, highlighting the significant impact of chronic respiratory conditions on overall physical performance (Belkadi et al., 2020; Tarmure et al., 2020).

The analysis of performance in physical test reveals some uniform decline in students suffering from chronic respiratory diseases in speed, strength, and even flexibility (Khelafi et al., 2011). For example, in the 30 m sprint test, boys were 13.9% and girls were 13.6% behind normal in 14 to 15year age cohort, and these trends are repeated in older age groups. This evidence may suggest that some underactivity of respiratory system can disrupt the function of muscle fibre, especially the type IIb fast twitch muscle fibres that are responsible for speeding up, achieving a desired rate of motion (Raghuveer et al., 2020). It is noteworthy that the strength tests, which include some features of athletics, for example, pull-ups, produced significant lags, especially for girls 69.2% at the age of 14 to 15 years and 71.0% at the age of 16 to 17 years (Carnethon et al., 2003). This suggests that chronic respiratory diseases may impose a disproportionate physiological strain on affected individuals (Mihailova & Kaminska, 2016). As noted by Neves (Neves et al., 2014), compromised respiratory efficiency is likely a key factor contributing to the observed reductions in mobility and endurance performance in this population.

CONCLUSION

This study examines the functional status of the cardiovascular and respiratory systems in students with and without chronic respiratory illnesses. The findings show significant differences in blood pressure, heart rate, lung function, and physical performance, underscoring the importance of specific procedures to improve the health and development of students with respiratory diseases. Addressing these discrepancies through personalized physical education programs and specialized healthcare has the potential to improve the quality of life and long-term health outcomes for this vulnerable population. Future research should look into the long-term consequences of these interventions, as well as other factors that may have an impact on the health and development of students with chronic respiratory disorders.

Implications and recommendations

This study reveals that interventions must be specifically tailored to meet the needs of students suffering from chronic respiratory diseases. Effective physical education programs for such students must make allowances for the diminished cardiovascular and respiratory functions by including some form of low impact aerobic exercises, strength building, and flexibility training. Most importantly, constant assessment of blood pressure, lung functionality, and heart rate must be conducted to determine when adjustments should be made to the patient's prescribed treatment plan. The gap in motor abilities and physical performance of healthy students as compared to those suffering from respiratory illnesses calls attention to early diagnosis and intervention for chronic respiratory ailments. There is a need for a joint effort between schools and the healthcare system

to screen affected students and make sure that they receive specialized care. In the same vein, lungs exercises and respiratory therapy can be integrated with physical education to improve the health status of these learners.

AUTHOR CONTRIBUTIONS

Abderrahman Abdelouaheb: study design, data collection, data analysis, and manuscript preparation. Zenati Yassine: data collection, data analysis, and manuscript preparation. Sifi Belkacem: data collection, data analysis, and manuscript preparation. Belkadi Adel: study design, data analysis, and manuscript preparation. Harbach Brahim: study design, data analysis, and manuscript preparation.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

Abdelkader, B., Adel, B., Yassine, Z., Otmane, B., Lalia, C., & Mohamed, S. (2021). Implementation of An Adapted Physical Activity Therapy Protocol for Patients with Low Back Pain. Gymnasium: Scientific Journal of Education, Sports & Health, 22(1). https://doi.org/10.29081/gsjesh.2021.22.1.06

Adel, B., Abdelkader, B., Alia, C., Othman, B., Mohamed, S., & Houcin, A. (2019). The Effect of High-Intensity Exercise on Changes of Blood Concentration Components in Algerian National Judo Athletes. Acta Facultatis Educationis Physicae Universitatis Comenianae, 59(2). https://doi.org/10.2478/afepuc-2019-0013

Beard, J. R., Officer, A., de Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J.-P., … Chatterji, S. (2016). The World report on ageing and health : A policy framework for healthy ageing. Lancet (London, England), 387(10033), 2145-2154. https://doi.org/10.1016/S0140-6736(15)00516-4

Beboucha, W., Belkadi, A., Benchehida, A., & Bengoua, A. (2021). The anthropometric and physiological characteristics of young Algerian soccer players. Acta Facultatis Educationis Physicae Universitatis Comenianae, 61(1). https://doi.org/10.2478/afepuc-2021-0004

Belkadi, A., Alia, C., & Mohammed, Z. (2020). Algerian Judo Competition Modality and its Impacts on Upper and Lower Limbs Strength Perseverance and Limitations. Orthopedics and Sports Medicine: Open Access Journal, 3(4), 293-299. https://doi.org/10.32474/OSMOAJ.2020.03.000168

Belkadi, A., Beboucha, W., Benhammou, S., Moussa, M., Bouzoualegh, M., & Dairi, A. (2025). Effects of concurrent in-season training on physiological functions required for top handball performance athletes. Scientific Journal of Sport and Performance, 4(1), 40-54. https://doi.org/10.55860/JIXW8099

Belkadi, A., Othman, B., Mohamed, S., M, B. H., Gleyse, J., Adel, B., … Gleyse, J. (2015). Contribution to the Identification of the Professional Skills Profile of Coaches in the Algerian Sport Judo System. International Journal of Sports Science, 5(4), 145-150.

Benhammou, S., Mourot, L., Mokkedes, M. I., Bengoua, A., & Belkadi, A. (2021). Assessment of maximal aerobic speed in runners with different performance levels : Interest of a new intermittent running test. Science & sports, 36(5), 413-e1. https://doi.org/10.1016/j.scispo.2020.10.002

Boudehri, M. E. amine, Belkadi, A., Dahoune, O., & Atallah, A. (2023). The effects of circuit exercise training strategy on health-related physical fitness level and biomarkers in elderly people with cardiovascular diseases. Quality in Sport, 11(1), 16-31. https://doi.org/10.12775/QS.2023.11.01.002

Carlson, S. A., Fulton, J. E., Schoenborn, C. A., & Loustalot, F. (2010). Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans. American Journal of Preventive Medicine, 39(4), 305-313. https://doi.org/10.1016/j.amepre.2010.06.006

Carnethon, M. R., Gidding, S. S., Nehgme, R., Sidney, S., Jacobs, J., David R., & Liu, K. (2003). Cardiorespiratory Fitness in Young Adulthood and the Development of Cardiovascular Disease Risk Factors. JAMA, 290(23), 3092-3100. https://doi.org/10.1001/jama.290.23.3092

Chen, B.-Y., Chao, H. J., Chan, C.-C., Lee, C.-T., Wu, H.-P., Cheng, T.-J., … Guo, Y. L. (2011). Effects of ambient particulate matter and fungal spores on lung function in schoolchildren. Pediatrics, 127(3), e690-698. https://doi.org/10.1542/peds.2010-1038

Cherara, L., Belkadi, A., Mesaliti, L., & Beboucha, W. (2022). Characteristics of Handgrip (Kumi-Kata) Profile of Georgian Elite Judo Athletes. GYMNASIUM, 23(1), 54-66. https://doi.org/10.29081/gsjesh.2022.23.1.04

Coe, D. P., Peterson, T., Blair, C., Schutten, M. C., & Peddie, H. (2013). Physical fitness, academic achievement, and socioeconomic status in school-aged youth. The Journal of School Health, 83(7), 500-507. https://doi.org/10.1111/josh.12058

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I.-M., … American College of Sports Medicine. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults : Guidance for prescribing exercise. Medicine and Science in Sports and Exercise, 43(7), 1334-1359. https://doi.org/10.1249/MSS.0b013e318213fefb

Khelafi, R., Aissanou, A., Tarsift, S., & Skander, F. (2011). Epidemiology of chronic obstructive pulmonary disease in Algiers]. Revue Des Maladies Respiratoires, 28(1), 32-40. https://doi.org/10.1016/j.rmr.2010.06.026

Krivolapchuk, I., Chernova, M., & Gerasimova, A. (2020). Effect of regular physical activity of various intensity on the functional status of 5-6 and 6-7-year-old children. Human Sport Medicine, 20(2), 71-79. https://doi.org/10.14529/hsm200209

Kuchma, V. R., P, K. B., Sukhareva, L. M., M, C. Л., Rapoport, I. K., Калмановна, P. И., … Ю, M. O. (2017). Population health of children, risks to health and sanitary and epidemiological wellbeing of students : Problems, ways of solution and technology of the activity. Hygiene and Sanitation, 96(10), 990-995. https://doi.org/10.18821/0016-9900-2017-96-10-990-995

Kuzmin, V. A., Kopylov, Y. A., Kudryavtsev, M. D., Tolstopyatov, I. A., Galimov, G. Y., & Ionova, O. M. (2016). Formation of professionally important qualities of students with weakened motor fitness using a health related and sport-oriented training program. Journal of Physical Education and Sport, 16(1), 136–145. https://doi.org/10.7752/jpes.2016.01023

Latorre-Román, P. Á., Navarro-Martínez, A. V., & García-Pinillos, F. (2014). The effectiveness of an indoor intermittent training program for improving lung function, physical capacity, body composition and quality of life in children with asthma. Journal of Asthma, 51(5), 544-551. https://doi.org/10.3109/02770903.2014.888573

Lee, D., Sui, X., Church, T. S., Lavie, C. J., Jackson, A. S., & Blair, S. N. (2012). Changes in Fitness and Fatness on the Development of Cardiovascular Disease Risk Factors : Hypertension, Metabolic

Syndrome, and Hypercholesterolemia. Journal of the American College of Cardiology, 59(7), 665-672. https://doi.org/10.1016/j.jacc.2011.11.013

Levick, J. R. (1991). Chapter 13-Cardiovascular receptors, reflexes and central control. In J. R. Levick (Éd.), An Introduction to Cardiovascular Physiology (p. 224-242). Butterworth-Heinemann. https://doi.org/10.1016/B978-0-7506-1028-5.50016-0

Luginina, V. V. (1960). The Stange-Hench test as a method of functional diagnosis of the cardiovascular system in children with diseases of the blood system]. Voprosy okhrany materinstva i detstva, 5, 62-66.

Lytvynenko, A., & Prontenko, K. (2020). Dynamics of Respiratory System Indices of Cadets of Higher Military Educational Institutions During Kettlebell Lifting Training. Retrieved form [Accessed 2025, May 06]: http://openarchive.nure.ua/handle/document/12220

Maggio, A. B. R., Hofer, M. F., Martin, X. E., Marchand, L. M., Beghetti, M., & Farpour-Lambert, N. J. (2010). Reduced physical activity level and cardiorespiratory fitness in children with chronic diseases. European Journal of Pediatrics, 169(10), 1187-1193. https://doi.org/10.1007/s00431-010-1199-2

Mahishale, A., & Kulkarni, N. (2014). Comparison of cardiovascular fitness of children 13-16 years of age from rural and urban areas of Belgaum district : A cross sectional study. Journal of the Scientific Society, 41(2), 79. https://doi.org/10.4103/0974-5009.132828

Manar, B., Adel, B., Lalia, C., & Saddak, B. (2023). Investigating the Impact of Physiological and Neuromuscular Performance in Highly Trained Judo Athletes of Different Weight Categories. Slobozhanskyi Herald of Science and Sport, 27(3), 118-127. https://doi.org/10.15391/snsv.2023-3.002

Meijer, A., Königs, M., de Bruijn, A. G. M., Visscher, C., Bosker, R. J., Hartman, E., & Oosterlaan, J. (2021). Cardiovascular fitness and executive functioning in primary school-aged children. Developmental Science, 24(2), e13019. https://doi.org/10.1111/desc.13019

Mihailova, A., & Kaminska, I. (2016). Lung volumes related to physical activity, physical fitness, aerobic capacity and body mass index in students. SHS Web of Conferences, 30, 00017. https://doi.org/10.1051/shsconf/20163000017

Millar, A. L., Fernhall, B., & Burkett, L. N. (1993). Effects of aerobic training in adolescents with Down syndrome. Medicine and Science in Sports and Exercise, 25(2), 270-274. https://doi.org/10.1249/00005768-199302000-00018

Moawd, S. A., Azab, A. R., Ibrahim, Z. M., Verma, A., & Abdelbasset, W. K. (2020). Impacts of Respiratory Muscle Training on Respiratory Functions, Maximal Exercise Capacity, Functional Performance, and Quality of Life in School-Aged Children with Postoperative Congenital Diaphragmatic Hernia. Disease Markers, 2020, 8829373. https://doi.org/10.1155/2020/8829373

Neves, L. M. T., Karsten, M., Neves, V. R., Beltrame, T., Borghi-Silva, A., & Catai, A. M. (2014). Respiratory muscle endurance is limited by lower ventilatory efficiency in post-myocardial infarction patients. Brazilian Journal of Physical Therapy, 18(1), 1-8. https://doi.org/10.1590/S1413-35552012005000134

Raghuveer, G., Hartz, J., Lubans, D., Takken, T., Wiltz, J., Mietus-Snyder, M., … Edwards, N. (2020). Cardiorespiratory Fitness in Youth - An Important Marker of Health : A Scientific Statement From the American Heart Association. Circulation, 142(7), e101-e118. https://doi.org/10.1161/CIR.0000000000000866

Rimdeikienė, I. (2023). The Improvement of Functional Condition and the Impact of Physiotherapy for Residual Symptoms in Patients Diagnosed with Post-Covid Syndrome. World Physiotherapy Congress 2023 : 2-4 June 2023, in Dubai, UAE / World Physiotherapy. [London] : World Physiotherapy, 2023. Retrieved form [Accessed 2025, May 06]: https://hdl.handle.net/20.500.12512/119320

Singh, R., Pattisapu, A., & Emery, M. S. (2020). US Physical Activity Guidelines : Current state, impact and future directions. Trends in Cardiovascular Medicine, 30(7), 407-412. https://doi.org/10.1016/j.tcm.2019.10.002

Soldatov, I. K., Константинович, С. И., Evdokimov, V. I., Иванович, Е. В., Arsentiev, V. G., Геннадиевич, А. В., … Юрьевна, Г. В. (2024). Indicators of health groups of pupils of general education organizations of the Russian Ministry of Defense (2010-2022). Russian Military Medical Academy Reports, 43(1), 41-48. https://doi.org/10.17816/rmmar623206

Tarmure, S., Alexescu, T. G., Orasan, O., Negrean, V., Sitar-Taut, A. V., Coste, S. C., & Todea, D. A. (2020). Influence of pesticides on respiratory pathology-A literature review. Annals of Agricultural and Environmental Medicine: AAEM, 27(2), 194-200. https://doi.org/10.26444/aaem/121899

Wittberg, R. A., Northrup, K. L., & Cottrell, L. A. (2012). Children's aerobic fitness and academic achievement : A longitudinal examination of students during their fifth and seventh grade years. American Journal of Public Health, 102(12), 2303-2307. https://doi.org/10.2105/AJPH.2011.300515

World Medical Association, W. M. (2013). World Medical Association Declaration of Helsinki : Ethical principles for medical research involving human subjects. JAMA, 310, 2191-2194. https://doi.org/10.1001/jama.2013.281053

Yacine, Z., Othmane, B., Adel, B., Mohamed, S., Aabdelkader, B., & Lalia, C. (2020). Functional movement screening as a predictor of injury in highly trained female's martial arts athletes. Polish Hyperbaric Research, 71(2), 67-74. https://doi.org/10.2478/phr-2020-0012

Yang, Y. J. (2019). An Overview of Current Physical Activity Recommendations in Primary Care. Korean Journal of Family Medicine, 40(3), 135-142. https://doi.org/10.4082/kjfm.19.0038

Zhu, K. Y., Yuan, F., & Yang, H. O. (2024). New progress in laboratory detection of respiratory infectious diseases in children. Zhonghua Yu Fang Yi Xue Za Zhi [Chinese Journal of Preventive Medicine], 58(9), 1458-1464.

Сарыг, С. К., Куулар, Ш. В., & Ондар, А. О. (2021). Adaptive features of the respiratory system of students who arrived from different regions of the republic of rt. Естественные и технические науки. https://doi.org/10.25633/ETN.2021.12.25