REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1S (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

Changes in Physical Health-Related Indexes of Delhi NCR school students post COVID-19 lockdown.

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Abstract:
Background: The COVID-19 pandemic and resulting lockdowns have impacted physical health and activity levels globally, particularly among school children. This study aims to examine the effects of COVID-19 infection and obesity on various physical health-related indices among students aged 15-17 years in Delhi NCR.

Objective: The objective of the study is to evaluate differences in body mass index (BMI), flexibility, explosive strength, muscle strength, and cardiorespiratory endurance between COVID-19 affected and unaffected students, and between obese and non-obese students.

Methods: This was a comparative study conducted on 80 school students aged 15-17 years using simple convenient sampling. The students were divided into four groups: (1) Obese and COVID-positive, (2) Obese and COVID-negative, (3) Non-obese and COVID-positive, and (4) Non-obese and COVID-negative. The outcome measures included BMI, flexibility, explosive strength, muscle strength, and cardiorespiratory endurance. Data analysis was performed using independent t-tests to compare physical health-related indices, with IBM SPSS Statistics Viewer version 21.

Results: No significant differences were observed between COVID-19 affected and unaffected students in any of the physical health-related indices. However, significant differences were found between obese and non-obese students in BMI ($p = 0.000$) and flexibility ($p = 0.000$). There were no significant differences in explosive strength ($p = 0.187$), muscle strength ($p = 0.076$), or cardiorespiratory endurance ($p = 0.001$) between the groups.

Conclusion: COVID-19 infection did not show a significant lasting impact on the physical health indices of students. However, obesity was linked with higher BMI and decreased flexibility. Obese students exhibited comparable explosive strength and muscle strength to non-obese students but should be encouraged to engage in activities that enhance physical activity and flexibility for improved long-term health outcomes.

Keywords: COVID-19, obesity, physical health, BMI, flexibility, strength, endurance, school students

INTRODUCTION

Since December 2019, a novel coronavirus infection has spread throughout China and the rest of the world, posing a threat to public health.[7] The first incidence of COVID-19 infection was made in Kerala, India. On January 27, 2020, a 20-year-old female presented to the emergency department of the public hospital in a city called Thrissur in Kerala.[10] As a preventive measure regarding the COVID-19 epidemic across the country of India, the authorities of India declared a 21-day statewide lockdown on the afternoon of March 24, 2020, prohibiting the mobility of the entire one billion and eighty-eight million (138 crores) citizens of India.[17] In order to stop and slow down the virus's transmission, as well as the numerous infections and fatalities that result from it.[18] The closure of schools and introduction of online instruction as a substitute was one of the most significant responses initiatives implemented by the Indian government.[20]

India's vast and diverse population faces significant challenges in gaining safe access to nutritional food, money, everyday needs, welfare services, and healthcare services in order to preserve their physical health. In these challenging times, it is difficult to keep up a healthy lifestyle, particularly for older people and those with pre-existing health concerns.[10] Many of these limits had an impact on the kid's daily activities as well as their physiological behavior. As a consequence, students were inclined to engage in inactive behaviors and probably received fewer opportunities to achieve the required amount of aerobic activity to maintain their mental and physical wellbeing.[1] A decrease in vigorous activity and bad food choices were discovered as being the major elements facilitating the harmful impact of COVID -19 protective measures on health. Recent global studies investigated the impact from the COVID19 lockout on elementary school kid's wellness behaviour changes and overall physical activity perception.[5] According to an increasing body of data, physical activity may have a significant impact on academic achievement across a range of cognitive, physiological, sentimental, and learning qualities, acting both directly and indirectly.[19] Furthermore, there has been a significant decrease In physical activity, especially among younger individuals. This may have a negative impact on medical aspects living and improve your risk of acquiring weight gain, along with cardiorespiratory and the metabolic illnesses.

Engaging in strenuous physical activity while performing cognitive tasks results in improved inhibited control, better working memory, and an extended attention span.[16] The phrase "physical activity" relates to any type of motion produced by skeletal muscles that entails an energy expenditure.[3] The shift in lifestyle resulting from COVID -19 lockdown procedures might have culminated in a rise in body mass index due to a rise in obesogenic characteristics such as lack of physical activity, enhanced sedentary behavior, including longer screen watching duration, and the use of bad eating.[5] According to Ekelund et al. (2016), vigorous activity can attenuate the harmful effects of sedentary behaviour and its link to mortality from all causes. The most recent evidences recommend that minimum 2 hours and 30 minutes of moderately strenuous (or 1 hour and 15 minutes of vigorous-intensity) cardiovascular activity per week, as well as exercises that strengthen the muscles twice a week or more. According to Anderson et al. along with Raziehh, Zacardi, Davis, Khunti, and Yates (2020), obesity is associated with greater rates of infection and an adverse COVID-19 prognosis. This is concerning because myhalf of the UK population self-reports gaining weight while on lockdown, and a two-third of the population at large is now obese and overweight(Duffy, 2020).[34] Physical activity has an impact on weight and the risk of COVID-19.Alcohol consumption, smoking, drug use, and unfavourable assessments of symptoms associated with depression, stressful personal experiences, occupational circumstances, body mass index, along with hypertension are all modifiable risk factors for mental health disorders. However, physical activity, societal encouragement, and the ability to cope were all regarded to be protective variables against mental illnesses. This was supported by a rise in the frequency of intake of ultra-processed meals among American adolescents, particularly females.[39] Sekulic et al., on the other hand, assessed alterations to PA levels prior to and 3 weeks past the enactment of COVID-19 regulations regarding social isolation and found a substantial reduction in physical activity scales for every participant in the study, and it was predominantly impacted by a substantial decrease in physical activity scales in males. Elnagar et. al. revealed in a similar manner that physical activity was reduced under the COVID-19 pandemic constraints, and that these adjustments were based on gender, with male adolescents exhibiting large decreases in comparison to female adolescents. The consumption of ultra-processed meals among American adolescents, particularly females, has skyrocketed. This was mostly attributable to a large reduction in the physical activity scales of younger men.[31]

Particularly in terms of physical health, individuals are becoming increasingly sedentary, and tools that helped them cope with anxieties throughout the lockdown are currently making them physically inactive.[35]

The shift in overweight alongside obesity occurrence among Croatian schoolchildren throughout the COVID-19 epidemic has remained to be determined. Between 2009 and 2015, the prevalence in overweight and obesity within children between 11 to 15 years in Croatia was over 18%, with males being more impacted.[5]

Because of the global COVID-19 outbreak, the entire household is experiencing a lot of stress. Many parents who have to handle work, raising children, and private life without much additional support find managing the lockdown throughout the epidemic challenging. Parents set standards for their children's healthy behavior, such as limiting screen time as well as promoting physical activity. When investigating the influence of sedentary behavior on the mental and physical wellbeing of children, one of the essential parental variables that must be considered is parental mental health.[17] Those with a BMI greater than 25 kg/m2 were more likely to gain weight in the COVID -19 lockdown in Croatia, whereas people who have an a body mass index below 25 kg/m2 had been susceptible to boost their physical activity and adhere to a Mediterranean-style diet. The new term "COVIBESITY" is meant to emphasize the correlation between obesity and the health impacts of covid19, as well as a spike in rate of obesity as a consequence of the lockdown precautions.[8] Not much is understood regarding the way these modifications impacted psychological and bodily health during a prolonged first lockdown, that was distinguished by abrupt and unforeseen shifts as well as a sense of uncertainty and worry.[14] COVID clearly resulted in a considerable drop in children's aerobic activity along with a growth in sedentary behavior.[13]

Weight gain is more closely associated to an absence of vigorous activity than to poor dietary choices, so increasing opportunities for physical activity must be prioritized.[11] Children who get the prescribed amount of physical activity grow strong, healthy joints and muscles, enhance their endurance in the body, lower their associated risk factors for chronic illnesses, boost their self-esteem and feeling of self-efficacy, and learn to handle stress and adverse feelings.[12]

Physical fitness is an essential measure of both current as well as future well-being. According to initial investigations on small samples of youngsters, lockdown tactics proved to have a significant detrimental impact on PF among youngsters and young adults. Physical activity appears to drop throughout adolescence, reported by the World Health Organization(WHO); over twenty percent of teenagers do not engage in any sort of physical activity. The COVID-19 epidemic has also resulted in a decrease in adolescent physical activity levels.[25] Certain living environments, including rural versus urban, are thought to influence nutritional intake and activity levels. Numerous studies have established that metropolitan areas have higher obesity rates and lower levels of physical activity compared to rural regions, and the COVID-19 epidemic only worsened the situation. Physical activity (PA) has been shown to improve children's health and happiness. A growing body of evidence shows that increasing the intensity of physical activity (PA) during childhood has been linked to a variety of the beneficial results, which includes enhanced bone and also cardio metabolic health, academic success, memory retention, and mental health.[38] Lopez et al. conducted an important study that assessed the influence of COVID-19 longterm exposure on VO2 max and revealed that just the adolescent girls

experienced a statistically significant reduction in VO2 max.[21] Although COVID-19 induced temporary alterations in children's PA levels, little is known about long-term changes that occurred afterwards the pandemic's first peak. Childhood and teenage obesity, in the long term, leads to obese adults, type 2 diabetes, cardiovascular disease, and other NCDs that result in preventable mortality and morbidity. It also raises the likelihood of mental health problems, exploitation, and poor academic achievement. One of the primary warning signs for childhood obesity is an unhealthy diet.[37]
This study sought to look into changes in BMI, strength, endurance, cardiorespiratory, and habits of school children aged 15 to 17 in Delhi NCR. The COVID-19 lockdown was thought to have boosted the overall incidence of increase in weight, obesity, durability, and strength.

Operational Definitions
METHODOLOGY
Type of study : Comparative study
Population unit : students between age 15-17 years
Area of sampling : Delhi
Sampling method : Simple Convenient Method
Inclusion Criteria and Exclusion Criteria
The inclusion criteria for the study required participants to be school students aged between 15 and 17 years. They needed to be capable and comfortable with performing all the required tests. Exclusion criteria included students who were diagnosed with any musculoskeletal, cardiorespiratory, or neurological conditions.

Participation
For this study, we targeted 80 students from different standards based on random selection to exclude any chance of biases. There were 49 male and 31 female students whom spontaneously signed up for the research investigation. The participants had all rights to withdraw their data and their participation at any point in time without any explanation requested. All the students were in proper health conditions and had no disabilities or disorders. We divided the data in different groups which were
1. Obese and COVID positive
2. Obese and COVID negative
3. Non-obese and COVID positive
4. Non-obese and COVID negative

Based on there obesity and COVID report and compared the above mentioned physical health related indexes of students of one group to students of another group.

DATA ANALYSIS
For analyzing the obtained data of various physical health related indexes of Independent t-test was used. The software named as IBM SPI Statics Viewer version 21 was used for analysis of the data in which we thoroughly compared flexibility, explosive strength, muscle strength and cardiorespiratory endurance.

RESULT
For the results, Body Mass Index, Cardiorespiratory Endurance, Flexibility, Explosive Strength and Muscle Strength and all the other variables are denoted in the graph as mean ± standard deviation. For the comparison of physical health related indexes of students between age 15-17 years to get post-COVID effects Independent t-test was used.

Table 1 :Comparison between students who where previously affected by *Physical Health* COVID Mean Std. Std. Sig. *Related Indexes* Deviation Error Mean

Explosive Strength	1	1.7143	.13407	.02283	.541
	2	1.6991	.13507	.01651	
BMI	1	26.081	6.0714	1.0262	.890
	2	24.632	6.0694	.7528	
Flexibility	1	11.029	10.9208	1.8460	.375
	2	10.662	11.5478	1.4323	
Muscle Strength	1	12.314	7.8507	1.3270	.693
	2	14.277	8.2263	1.0203	
Cardiorespiratory	1	96.686	14.5274	2.4556	.340
	2	93.677	14.2117	1.7627	

COVID-19 and students who never get affected by COVID-19.

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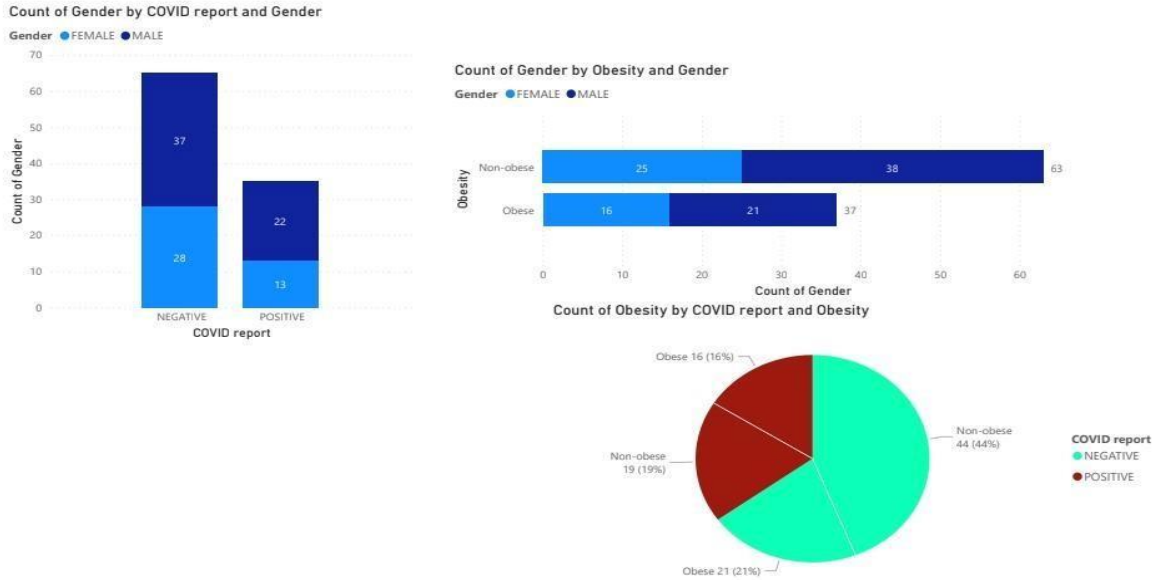
The significant data for the physical health related indexes in comparing COVID positive students with COVID negative students are as follows, for explosive strength .541, for BMI .890, for flexibility .375, for muscle strength .693, and for cardiorespiratory .340, as the significance data of all indexes is exceeding the desired value of 0.05 so the obtained data is statistically insignificant(as shown in Table 1).
The reason behind the insignificance of the indexes in comparison over COVID report is likely due to the time lap between the spread of COVID-19 and the collection of data. The students had pretty much recovered physically by that time which is why there weren't much differences in COVID positive and COVID negative students.

Physical Health Related Indexes	Obesity	Mean	Std. Deviation	Std. Error Mean	Sig.
BMI	1	21.197	3.8468	.4847	.000
	2	31.852	1.6236	.2669	
Flexibility	1	14.349	12.4410	1.5674	.000
	2	4.730	4.8284	.7938	
Explosive Strength	1	1.7560	.10725	.01351	.187
	2	1.6165	.12822	.02108	
Muscle Strength	1	17.889	6.3984	.8061	.076
	2	6.270	4.7996	.7890	
Cardiorespiratory	1	91.429	15.3294	1.9313	.001
	2	100.351	10.3849	1.7073	

Table 2: Comparison between Obese students and Non-obese students

The another comparison based on obesity the significant data for all the examined indexes are as follows, for Explosive strength .187, for BMI .000, for flexibility .000, for muscle strength .076, for cardiorespiratory .001 as per the data found after analysis the BMI, flexibility, and cardiorespiratory data are significant but explosive strength and muscle strength are insignificant(as shown in Table 2).Which gives the idea that the obese students don't have the same flexibility or Cardiorespiratory function as the non-obese students but the still posses almost similar explosive and muscular strength to handle there body.



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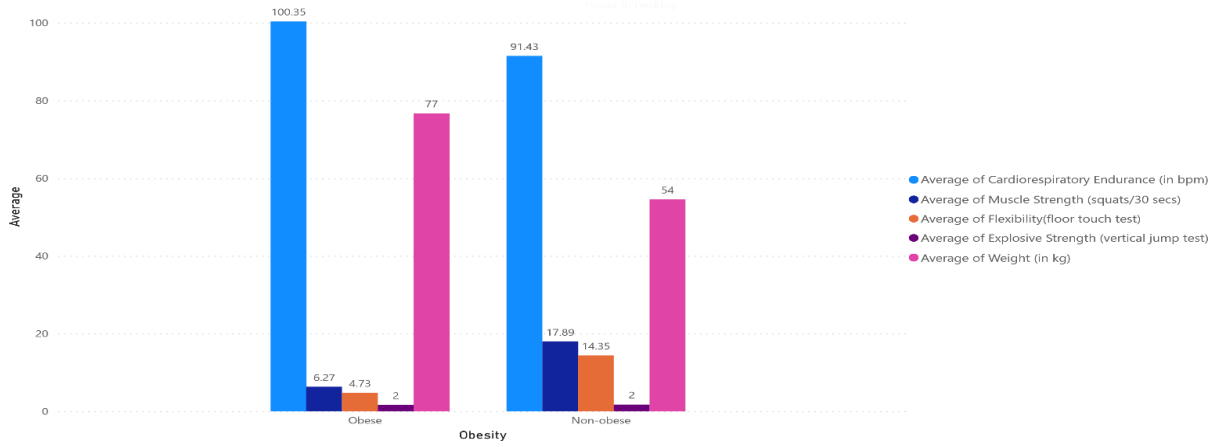

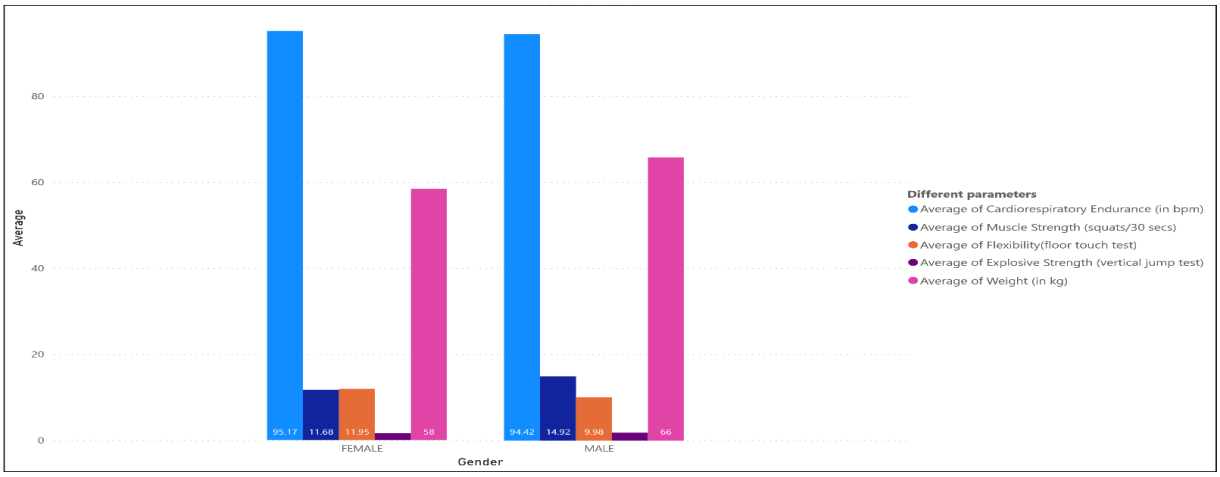

DISCUSSION

As found in analyzing the collected data, the physical health related indexes which were BMI, Flexibility, Explosive Strength, Muscle Strength and Cardiorespiratory Endurance in comparing COVID affected students with COVID not affected students had no significant changes whereas as for obese and non-obese students the BMI and Flexibility had shown some significant changes except them all other Physical Health Related Indexes where insignificant on comparison.

According to Donglin Hu and colleagues, BMI increased and lowered energy expenditure, resilience, and strength performance, implying that studying online throughout the global epidemic shutdown may have an effect on teenagers' healthrelated indicators. Because COVID has been a long time ago, there is little probability of detecting any changes in physical health.[4]

According to Clemens Drenowatz et al, children with COVID-19 had considerably higher BMIPCT, with a more apparent rise in girls. It was unsurprising that weight had become an issue. COVID-19 regulations have been found in numerous research around the world to have a negative impact on body weight. This study found no significant differences in BMI between COVID-affected and non-affected pupils, but substantial differences in obese children.[22]

Flexibility, as measured by seated forward bends, showed no significant differences between COVID-19 impacted and COVID-19 unaffected pupils. However, there are considerable differences in flexibility between obese and non-obese students. In 2021, in general modifications to mobility declined in Levels 1 and 2. The differences witnessed in both female and male pupils in their final year of elementary school and their initial year of secondary school were especially striking. The most recent research by a team of researchers found that a 16-week health activity program for teenagers improved flexibility significantly(before = 2.64 3.49, post = 5.98 2.78). Stretching, both static and dynamic, can increase flexibility.[29]

This result showed that no significant changes in cardiorespiratory endurance were observed due to the time gap between the COVID-19 pandemic and the data collection in 2023, so there are no changes in cardiorespiratory endurance, whereas physical activity/exercise can improve cardiorespiratory fitness in addition to increasing the human body's immune system. Donglin Hu et al., on the other hand, demonstrated lower cardiorespiratory endurance.[3] Similarly, no significant differences were detected when comparing obese and non-obesity pupils, although outcomes were obtained in Slovenian youngsters throughout the epidemic, with endurance capabilities (long way sprinting) exhibiting largest reductions.[25]

As a result of social isolation and school closures, muscle strength had no significant changes when comparing COVID affected students and COVID not affected students. As we all know, in the year 2019, a new variant of coronavirus emerged as the source of an influenza epidemic that developed in worldwide, but the data was collected in 2023, almost two years has passed, making it difficult to time any changes in explosive strength when comparing with COVID-19 affected pupils and COVID-19 unaffected pupils. According to Eui-Jae Lee, there had been no substantial alteration in muscle power for middle school or secondary school students. The Chi-square readings for the years 2019 and 2021 did not prove statistically noteworthy, nor did these individuals indicate a substantial loss in muscle power. Physical activity declined significantly for senior citizens across the COVID-19 pandemic, according to a research by Sagarra-Romero and Vias-Barros, and this decline in physical fitness was severe.[32] There are no substantial differences between obese and non-obese students. Muscular strength is acquired in part by doing simple motions and workouts at house in all aspects of everyday activities. As a result, improvements in physical activity outside of the home may have little impact.

When comparing COVID afflicted kids to COVID unaffected students, and obese students to non fat students, there were no significant differences in explosive strength as measured by standing long jump. As a result of this study, it was discovered that there are significant (BMI, Flexibility) differences between obese and non-obese students, but no significant differences between COVID-19 affected and COVID-unaffected students in physical health related index.

CONCLUSION

After analyzing the results which shows significant differences in BMI and Flexibility between Obese and non-obese students except that in Muscle Strength, Explosive Strength and Cardiorespiratory Endurance there were no significant differences, whereas in any physical health related indexes between COVID affected and COVID not affected students there were not any significant difference found in any of the examined index. Thus, the conclusion of this study shows that the in age group 15-17 years, the students who got affected by COVID-19 previously has completely healed physically as there is no effect of COVID-19 found on there Physical Health Related Indexes, as for obese students, there were some effects of obesity found on there Physical Health Related Indexes, they have higher BMI because of there higher bodyweight in same height ratio and are comparatively less flexible than non-obese students, except that both non-obese and obese students have enough strength and endurance to easily handle there own body weight. The obese students should increase there physical activity and should work on there muscles flexibility to have a healthier lifestyle and decrease chances of many health related issues in upcoming future.

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