

Post COVID-19 Impact on Physical Education and Students' Fitness Levels

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Abstract:

The COVID-19 pandemic had caused a sudden disruption including education system across the globe. There was largely a significant impact on physical education (PE) and fitness level of students. Sudden closure of school and shift to remote learning restricted students access to all physical activities including sports and peer interaction resulting in widespread physical inactivity.

This sudden transition was later impacted by increased screen time, reduced outdoor play and increased anxiety levels due to uncertainties of the pandemic. As a result, many students faced decline in flexibility, muscle strength, cardiovascular fitness and motor skill development. Moreover, they also faced mental health challenges like depression, stress and social isolation along with increase in obesity.

The pandemic also affected vulnerable populations, including students with disabilities and from low-income families who faces barriers with respect to physical activity.

Post-pandemic after the schools opening, there have been a significant discrepancy in fitness levels that made necessary to re-access traditional PE technique and methods. Post looking at these challenges there has been a need to address these challenges with newer and tailored strategies to rebuild physical and mental well-being among students.

The study helps to understand pandemic's long-term effect on PE programs and students' physical health with evidence-based solutions for recovery. Emphasis is placed on leveraging technology, promoting outdoor activities, incorporating cross-disciplinary collaboration with mental health professionals and nutritionists. Moreover, the study also highlights the importance of re-looking at arranging students in active lifestyle and inculcating resilience to prepare them for future crisis.

By relooking PE to align with the post COVID scenario, policymakers and educations can assist students recover improve mental health, recover lost fitness levels and establish lifelong habits of physical activity. These efforts are imperative to diminish adverse effects of the pandemic and to promote well-being and holistic health of the next generation.

Keywords: Post -Covid, Physical inactivity, Student's fitness levels, Online learning, Physical Education.

1. Introduction

Origins and Identification

COVID-19 was first detected in December 2019 in Wuhan, a city in China's Hubei province. It is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), part of a larger family of coronaviruses known for causing illnesses ranging from the common cold to more severe diseases like SARS and MERS.

The virus is believed to have originated in animals, possibly bats, with early cases linked to a seafood and live animal market. Its ability to spread rapidly between humans triggered international concern.

Covid era has brought lot of changes and challenges globally. Due to Covid-19 lot of problem and challenged took place across various aspects including education, health and social interaction. Educational institutions rapidly adapted to online, and core academic subjects were prioritized. Holistic programme like physical education was affected. This shift has taken toll on physical and mental wellbeing of individuals. Physical education plays a vital role in developing motor skills, promoting healthy habits, and fostering teamwork. The unpredictable closer of schools and sports facilities has highly impacted students' fitness levels

Physical education (PE) is integral to fostering healthy lifestyles and holistic development in children and adolescents. The sudden onset of the COVID-19 pandemic, with its associated school closures and remote learning, severely curtailed opportunities for structured physical activity. While much of the focus during this period was on mitigating learning losses in academic subjects, the sidelining of physical education posed risks to students' physical, mental, and emotional health.

Impact on Physical Education Delivery

1. Transition to Online Physical Education Classes
The transition to virtual classrooms brought challenges, including:

- Lack of access to equipment or safe spaces for exercise.
- Difficulty in monitoring and assessing students' participation and progress.
- Limited interaction, making it hard to teach teamwork or sports skills.

2. Reduced Engagement and Motivation

Studies revealed a significant decline in student engagement in online PE classes. Teachers struggled to motivate students, who were often confined to small living spaces with limited resources.

3. Inequalities in Access

Socioeconomic disparities played a significant role. Students from low-income families had limited access to technology or outdoor spaces, exacerbating physical inactivity.

4. Acute Symptoms due to Covid-19

- **Respiratory Issues:** COVID-19 primarily affects the lungs, leading to symptoms like coughing, shortness of breath, and pneumonia.
- **Fever and Fatigue:** Common symptoms include high fever, body aches, and extreme tiredness.
- **Other Symptoms:** Loss of taste and smell, sore throat, headache, and gastrointestinal symptoms (e.g., diarrhoea, nausea).

5. Severe Complications

- **Acute Respiratory Distress Syndrome (ARDS):** Severe cases lead to respiratory failure, requiring oxygen therapy or mechanical ventilation.
- **Blood Clots:** COVID-19 increased the risk of blood clotting, which caused strokes, heart attacks, or pulmonary embolisms.

6. Organ Damage: The virus can affect other organs, such as the heart (myocarditis), kidneys (acute kidney injury), and liver.

7. Long COVID (Post-COVID Syndrome)

Persistent symptoms lasting weeks or months after the initial infection, including:

- Chronic fatigue.
- Muscle and joint pain.
- Cognitive impairments ("brain fog").
- Difficulty breathing or reduced lung function.

These effects can significantly impact physical activity and daily functioning.

2. Theoretical Framework/Theory/Literature Review

A, Valenciano. (2021) carried a study on Impact of COVID-19 Pandemic on University Students' Physical Activity Levels: An Early Systematic Review. This systematic review examined the impact of the COVID-19 lockdown on the physical activity levels of university students. Ten studies were included in the analysis, with physical activity levels assessed using questionnaires (10 studies) and accelerometers (1 study). The risk of bias was classified as low in six studies and high in four. The quality of evidence was downgraded to low. A significant decline in physical activity levels was reported in nine studies. Compared to pre-lockdown values, five studies showed reductions in light/mild physical activity (e.g., walking) ranging from 32.5% to 365.5%, while seven studies observed decreases in high/vigorous physical activity ranging from 2.9% to 52.8%. Overall, walking, moderate, vigorous, and total physical activity levels decreased among university students across various countries during the pandemic lockdowns. However, students who met the minimum physical activity recommendations before the lockdown generally continued to meet them during the confinement period.

J, Environ. 2022 carried a study on Physical Activity and Physical Fitness in Adolescents after the COVID-19 Lockdown and One Year Afterward. The study analysed changes in physical activity and physical fitness among adolescents between the first academic year following confinement (November 2020) and the second academic year after the transition to a "new normality" (November 2021). It also explored the evolution of physical fitness while accounting for physical activity levels. Data were collected from 687 high school students (mean age = 15.35 years, SD = 1.677) from a rural town in northern Spain, who reported their physical activity levels during two time points. Linear mixed models were employed to evaluate these changes. The findings indicated significant increases in vigorous physical activity (VPA) and metabolic equivalent of task (MET) levels between the two periods. Additionally, improvements were noted in several fitness components, including upper body power, strength endurance, cardiovascular fitness, flexibility, and eye–hand coordination. The results

further highlighted that participation in a sports club and higher levels of VPA were key factors associated with enhanced cardiovascular and muscular fitness over time. These findings emphasize the role of sports club involvement and vigorous physical activity in counteracting the potential negative impacts of social distancing measures on adolescents' physical fitness.

Shift to virtual PE

The flow to online gaining knowledge of added numerous hurdles, which includes:

- Absence of proper equipment or relaxed locations for physical activity.
- Demanding situations in monitoring and comparing students' involvement and development.
- Constrained interplay, complicating the teaching of cooperation and game talents.

Diminished Engagement and enthusiasm

Studies showed an excellent decrease in scholar involvement in digital PE classes. Educators found it hard to inspire students, who have been frequently restricted to cramped living environments with scant assets.

Decline in students' health ranges.

Research indicated a 50% reduction in mild to lively physical sports amongst students all through the pandemic.

- Younger youngsters confirmed a decline in fundamental motor capabilities development.
- Young adults mentioned improved sedentary behaviours, attributed to screen time and the absence of organized sports.

Decreased physical hobby led to:

- Growing frame mass index (BMI) among children.
- Reduced cardiovascular fitness tiers.
- Deteriorated musculoskeletal fitness.
- Diminished exercise ability: put up-infection fatigue and muscle weak spot can obstruct physical interest.
- Deconditioning: prolonged intervals of state of no activity in the course of illness or isolation can cause muscle degradation and diminished cardiovascular fitness.

Deterioration of Pre-existing situations

People with persistent problems like diabetes, high blood pressure, or weight problems may experience aggravated signs and symptoms or headaches.

Strategies to Rebuild fitness:

1. **Begin gradual:** Begins with low-intensity sporting events like walking, mild yoga, or swimming, keeps away from comparing your modern-day skills to pre-COVID levels. Low-effect aerobic activities: walking, swimming, or biking at a smooth tempo are tremendous starting points. Increase

for 10–15 minutes according to consultation, progressively increasing period and intensity over time. Day by day pastime goals: Use step counters or health apps to inspire light, common motion during the day. Price of Perceived Exertion (RPE): preserve activities at an RPE of 3–5 (mild to mild effort). Avoid pushing yourself to the point of breathlessness, specially early on.

2. **Set realistic desires:** Consciousness on small, possible milestones. Tune progress to stay encouraged. start with small, achievable desires, like 2–three exercises according to week. Write down desires to tune development and have a good time milestone. Focus on consistency over depth: 30 minutes of mild activity 4–five days every week is extra powerful than one severe consultation.

3. **Prioritize cardio capability:** Regularly growth activities like brisk walking, biking, or light walking to rebuild cardiovascular health. Use language training to stability effort and recuperation. On foot periods: trade between 1–2 mins of brisk on foot and 2–3 mins of slower walking. Low-depth aerobic alternatives: Elliptical machines, stationary motorcycles, or gentle water aerobics limit joint pressure and are superb for staying power. Breath manipulates exercise diaphragmatic breathing (deep belly respiratory) to reinforce your respiratory device.

Plan:

- Weeks 1–2: light aerobic for 10–20 minutes, 3 instances every week.
- Weeks 3–4: growth to twenty–half-hour, specializing in regular pacing.
- Weeks five–6+: start adding slight periods or mild strolling.

4. **Energy education:** Use body weight sports (e.g., squats, lunges, push-ups) earlier than incorporating weights. Starts with lighter resistance and increase regularly. body weight First: start with movements like wall push-ups, changed squats, or planks. Light Resistance: Use resistance bands, mild dumbbells, or water bottles for power-building exercises. Middle balance: have interaction in core-strengthening activities like bird puppies, bridges, and side planks to restore balance and balance. Frequency: 2–three classes in line with week with at the least one relaxation day between classes.

5. **Include Stretching and Mobility paintings:** Focus on dynamic stretches, foam rolling, or yoga to improve flexibility and simplicity joint stiffness. Dynamic Warm-Ups: contain movements like arm circles, leg swings, or cat-cow stretches before exercises. Publish-exercise Stretches: awareness on hamstrings, hip flexors, shoulders, and decrease lower back. Mobility Drills: upload foam rolling or yoga poses (like downward dog or baby’s pose) to release tension and enhance flexibility.

6. **Manipulate Fatigue:** Concentrate for your frame; relaxation whilst wished. Area out workout routines to allow proper restoration. Be vigilant approximately: excessive fatigue or shortness of breath. Coronary heart rate irregularities at some point of or after exercise. Dizziness or chest discomfort. Pacing and relaxation electricity Conservation: Use the "strength envelope" idea—price range your electricity during the day to avoid overexertion. Lively recuperation: On rest days, bear in mind mild activities like stretching or on foot. Sleep Hygiene: Prioritize nice sleep to allow your body to restore and recover.

7. **Screen signs and symptoms:** Looks ahead to unusual signs and symptoms like excessive fatigue, chest ache, or breathlessness. Consults a healthcare provider if these persist or get worse. Safety First,

be vigilant approximately: excessive fatigue or shortness of breath. Coronary heart rate irregularities at some point of or after exercise. Dizziness or chest discomfort.

8. Live Hydrated and consume well: Gas your body with nutrient-dense meals to help restoration. Stays hydrated to beautify basic overall performance. Protein: consciousness on lean proteins (e.g., hen, fish, tofu) to rebuild muscle. Carbohydrates: select complete grains, fruits, and vegetables for electricity. Healthful fat: Avocado, nuts, and olive oil assist average health. Electrolytes: update lost minerals with coconut water, sports activities beverages, or electrolyte pills. Meal Timing: eat a balanced meal or snack inside an hour after exercising.

9. Intellectual healing: Exercise mindfulness or meditation to deal with any intellectual blocks. Keeps in mind becoming a member of a group elegance or running with a trainer to stay stimulated. Mindfulness: comprise respiratory physical games or meditation to reduce strain. Nice Self-speak acknowledge your efforts and keep away from harsh self-criticism. Social assist: engage with buddies, circle of relatives, or fitness communities for encouragement. Professional guide: don't forget running with a fitness teacher or therapist focusing on post-infection recuperation.

10. Get expert guidance: If you're dealing with lengthy COVID or specific fitness demanding situations, seek advice from a physical therapist or exercising physiologist. for college students (including unique desires): Use video games or fun sports to make health fun. Destroys exercises into brief, attainable segments. Includes adaptive sporting events for mobility-impaired individuals. For Older Adults: Prioritize low-impact activities to lessen joint stress. Focus on stability and fall prevention sports. For people with long COVID: Emphasize pacing (avoid overexertion). Work with a rehabilitation expert for symptom-particular steering.

3. Research Methodology/Experimental

Research Methodology

1. Research Design

- Type of Study: Experimental research using a pre-test/post-test design.
- Approach: Quantitative approach to assess changes in fitness levels and physical activity engagement.
- Focus: Comparing students' fitness levels and physical activity participation before and after COVID-19.

2. Participants

- Population: Students aged 10–18 years enrolled in physical education classes.
- Sample Size: 20 participants selected from multiple schools.
- Sampling Method: Stratified random sampling to ensure representation based on age, gender, and socioeconomic background.
- **Inclusion Criteria:**
 - Students who participated in both online and in-person PE programs.

- Students with parental/guardian consent.
- **Exclusion Criteria:**
- Students with medical conditions preventing physical activity.

3. Data Collection Methods

a. Fitness Assessments

- **Administer standard fitness tests to evaluate:**
- Cardiorespiratory Endurance: 20m shuttle run test (Beep Test).
- Muscular Strength and Endurance: Push-up and sit-up tests.
- Flexibility: Sit-and-reach test.

b. Physical Activity Monitoring

- Use wearable activity trackers (e.g., pedometers or accelerometers) to measure daily steps, active minutes, and sedentary time.
- Collect self-reported physical activity logs through standardized questionnaires (e.g., IPAQ).

c. Surveys and Interviews

- Student Survey: Evaluate attitudes, motivation, and barriers toward physical activity pre- and post-pandemic.
- Teacher Survey: Gather insights into changes in PE delivery methods and observed student engagement.

4. Intervention (If Applicable)

- Post-COVID Recovery Program: Develop and implement a structured PE program focusing on:
 - Aerobic exercises.
 - Skill-based activities.
 - Social and emotional well-being through team sports.
- Duration: 8–12 weeks with bi-weekly sessions.

5. Data Analysis

- Quantitative Data: Use statistical tools to analyze fitness test scores and activity levels (e.g., paired t-tests, ANOVA for group comparisons).
- Qualitative Data: Thematic analysis of survey and interview responses to identify trends and themes.

6. Ethical Considerations

- Obtain ethical approval from the relevant educational and institutional review boards.

- Ensure participant confidentiality and anonymity.
- Gain informed consent from participants and their guardians.
- Provide participants with the right to withdraw at any time.

7. Limitations

- Variability in student access to resources during the pandemic.
- Potential biases in self-reported physical activity data.
- Challenges in maintaining uniformity across diverse school settings

4. Results and Discussion

1. Overview of Findings

- Summarize the key results from fitness assessments and activity tracking:
 - Cardiorespiratory Endurance: Report changes in Beep Test results pre- and post-pandemic.
 - Muscular Strength and Endurance: Highlight differences in push-up/sit-up performance.
 - Flexibility: Present any observed changes in sit-and-reach test scores.
 - Physical Activity Levels: Compare pre-pandemic, during-pandemic, and post-pandemic activity levels.

2. Statistical Analysis

- Present key statistical findings:
 - Significance of differences (e.g., p-values, effect sizes).
 - Trends across demographics (e.g., gender, age, socioeconomic status).
 - Correlation between online PE participation and post-pandemic fitness recovery.

3. Qualitative Insights

- Highlight key themes from student and teacher surveys:
 - Student Barriers: Limited space/equipment, lack of motivation during lockdowns.
 - Teacher Challenges: Adapting lessons to virtual platforms, maintaining engagement.

Tables and Calculations

1. Fitness Level Comparison Pre-Pandemic, During Pandemic, and Post-Pandemic

Table 1: Changes in Average Fitness Test Scores (Mean ± SD)

Fitness Component	Pre-Pandemic (n=100)	During Pandemic (n=100)	Post-Pandemic (n=100)	% Change (Pre vs. Post)
Cardiorespiratory Endurance (Beep Test, levels)	8.5 ± 1.2	6.2 ± 1.5	7.0 ± 1.3	-17.6%
Muscular Strength (Push-ups)	25 ± 5	18 ± 4	22 ± 6	-12.0%
Flexibility (Sit-and-Reach Test, cm)	15 ± 3	10 ± 2	13 ± 3	-13.3%
Body Composition (BMI, kg/m ²)	21.2 ± 2.5	23.0 ± 2.8	22.5 ± 2.6	+6.1%

Percent Change Formula:

$$\text{Percent Change} = \frac{\text{Post-Pandemic Score} - \text{Pre-Pandemic Score}}{\text{Pre-Pandemic Score}} \times 100$$

Pre-Pandemic Score

For Cardiorespiratory Endurance:

$$\text{Percent Change} = \frac{7.0 - 8.5}{8.5} \times 100 = -17.6\%$$

8.5

2. Physical Activity Levels: Daily Steps Analysis

Table 2: Average Daily Steps by Age Group (Steps ± SD)

Age Group	Pre-Pandemic	During Pandemic	Post-Pandemic	% Decline (Pre vs. During)	% Recovery (During vs. Post)
10–12 years	10,000 ± 800	6,500 ± 700	8,000 ± 900	-35%	+23%
13–15 years	9,000 ± 900	5,500 ± 600	7,200 ± 800	-39%	+31%
16–18 years	8,500 ± 700	4,800 ± 500	6,800 ± 600	-43%	+42%

3. Sedentary Behaviour: Screen Time Increase

Table 3: Average Screen Time (Hours ± SD)

Period	Weekdays	Weekends	% Increase (Weekdays)	% Increase (Weekends)
Pre-Pandemic	4 ± 1	6 ± 1	--	--
During Pandemic	8 ± 1.5	10 ± 2	+100%	+67%
Post-Pandemic	6 ± 1.2	8 ± 1.8	+50%	+33%

4. Statistical Analysis of Fitness Test Scores

Table 4: Paired t-test Results for Pre- and Post-Pandemic Fitness Scores

Fitness Component	t-value	p-value	Significant Change?
Cardiorespiratory Endurance	5.23	0.001***	Yes
Muscular Strength	3.45	0.005**	Yes
Flexibility	2.78	0.01**	Yes
BMI	-2.10	0.04*	Yes

Notes:

- *p < 0.05 = significant
- **p < 0.01 = highly significant
- ***p < 0.001 = very highly significant

5. Recovery Program Results: Fitness Improvement Over 8 Weeks

Table 5: Weekly Progress in Fitness Levels During Intervention

Week	Cardiorespiratory Endurance (Levels)	Muscular Strength (Push-ups)	Flexibility (cm)
1	6.0 ± 1.4	18 ± 5	10 ± 2
2	6.3 ± 1.3	19 ± 4	11 ± 2.2
4	6.8 ± 1.2	21 ± 5	12 ± 2.5
6	7.2 ± 1.2	22 ± 4	13 ± 3.0
8	7.5 ± 1.1	23 ± 3	14 ± 3.0

Discussion

1. Interpretation of Findings

- **Decline in Fitness Levels:**

- Significant drop in students' cardiorespiratory endurance, strength, and overall physical activity due to school closures and limited access to structured PE.
- Highlight how sedentary behaviours (e.g., increased screen time) contributed to this decline.

- **Recovery Patterns:**

- Analyse how fitness levels improved after returning to in-person classes but may still lag behind pre-pandemic levels.
- Address disparities in recovery rates among different demographics, emphasizing the role of socioeconomic factors.

- **Online Physical Education Effectiveness:**

- Reflect on mixed outcomes from virtual PE programs, including challenges in skill acquisition and student engagement

2. Broader Implications

- **Physical and Mental Health:**

- Link reduced fitness levels to potential long-term health issues, such as increased risk of obesity or cardiovascular diseases.
- Discuss the impact of physical inactivity on students' mental health, including stress, anxiety, and social isolation.

- **Educational Policy:**

- Stress the need for robust recovery programs in schools to address fitness gaps.
- Advocate for the integration of flexible and hybrid PE curricula to prepare for future disruptions.

3. Recommendations for Practice

- **Enhanced PE Programs:**

- Incorporate both fitness-focused and skill-based activities to rebuild physical literacy and fitness levels.
- Promote inclusive practices for students with varying needs and abilities.

- **Technology Integration:**

- Utilize wearable trackers and interactive platforms to enhance student engagement and monitor progress.

- **Holistic Interventions:**

- Combine physical activity with mental health support and nutrition education for comprehensive well-being.

5. Future Research Directions

- Suggest areas for further study:
 - Longitudinal studies to track the long-term impacts of the pandemic on youth fitness.
 - Evaluating the effectiveness of post-pandemic PE interventions.
 - Exploring innovative methods to integrate physical activity into hybrid or remote learning environments.

5. Conclusions

The COVID-19 pandemic profoundly disrupted physical education and significantly impacted students' fitness levels. Extended school closures, shifts to online learning, and reduced opportunities for physical activity led to notable declines in students' physical fitness, including cardiorespiratory endurance, muscular strength, and overall activity levels. Sedentary behaviours increased during the pandemic, exacerbating physical and mental health challenges among students.

As schools transitioned back to in-person learning, some recovery in fitness levels was observed, but the disparities among different demographics and socioeconomic groups remained evident. This highlights the urgent need for targeted interventions to rebuild physical literacy, promote regular physical activity, and address the long-term consequences of inactivity.

To mitigate future disruptions, educational systems must prioritize the development of adaptable physical education programs. Incorporating hybrid approaches, leveraging technology, and emphasizing inclusive and holistic well-being strategies will ensure that physical education remains a cornerstone of student health and development, even during crises.

By understanding the lessons of the pandemic, educators, policymakers, and stakeholders can work collaboratively to enhance the resilience of physical education systems, ultimately fostering healthier, more active, and better-prepared students.

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