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ORIGINAL RESEARCH

# Physical Activity Adaptations in Vietnam during COVID-19

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## Abstract

*The COVID-19 pandemic presented a severe global health crisis. Countries worldwide have implemented various strategies to counteract COVID-19, such as social distancing, self-isolation, and quarantine regulations. The sudden changes affected people's lifestyles, including physical activity (PA). This study investigated the impact of the COVID-19 pandemic on PA in Vietnam. Based on the small-scale online survey data involving 627 respondents, results showed that most of them tried to preserve their exercise habits during the outbreak, perceiving exercise as necessary to improve health and prevent illness during the pandemic. People managed to maintain their sports activities; some even increased their PA levels from pre-pandemic levels. There was a noticeable decrease in playing sports that required gatherings, specialised infrastructure, and equipment. Most respondents preferred individual training during the pandemic; some new forms of PA, such as practising in small groups via online guidelines, were developed. The findings reveal that the Vietnamese respondents adapted their PA given the restrictions of the pandemic. Recommendations include considering online and home-based exercise programs to promote PA during similar public health emergencies requiring quarantine measures.*

**Keywords:**
exercise, health, pandemic, physical activity, well-being

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## Introduction

The COVID-19 pandemic and its rapid spread have caused a massive global health crisis (Bentlage et al., 2020; Coen, 2023). Data shows that over 676 million people across the globe have been infected, with more than 6.8 million related deaths since the pandemic outbreak in December 2019 (Center for Systems Science and Engineering, 2023). Governments in various countries have implemented innumerable strategies, including physical distancing and self-isolation regulations, to control the spread of the virus and reduce the risk to national healthcare systems (Sallis et al., 2020). These have resulted in radical changes in the lifestyle of people, in particular, a reduction in physical activity (PA) and exercise and an

increase in sedentary behaviours that compromise immune function and raise the risks for long-term health conditions (Alshammari et al., 2024; Dadswell et al., 2023; Sallis et al., 2020).

Recent cross-border investigations have revealed the profound impact of COVID-19 limits on people's PA (Alshammari et al., 2024; Bourdas & Zacharakis, 2020; Constandt et al., 2020; Corrado et al., 2020; Faulkner et al., 2020; Katewongsa et al., 2020; Mutz & Gerke, 2020; Richardson et al., 2020). The research also suggested that intensive restrictions on people's free movement and contact may reduce the risk of virus transmission in the community. However, a reduction in PA may trigger the development of other non-communicable diseases and, consequently, an increase in death rates (World Health Organization, 2002, 2018).

According to the World Health Organization (2018), PA refers to any bodily movement produced by skeletal muscles requiring energy expenditure. In contrast, exercise is a planned, structured, and repetitive subcategory to improve or maintain one or more components of physical fitness. World Health Organization (2022) recommends at least 150 minutes of moderate-intensity aerobic PA throughout the week for adults aged 18–64. This guideline suggests that an average daily exercise duration could reasonably approach one hour, particularly when considering days with more intensive activity sessions. This recommendation is based on extensive research indicating that regular PA provides numerous health benefits, such as improved muscular and cardiorespiratory fitness, better bone health, and a reduced risk of hypertension, coronary heart disease, stroke, diabetes, and certain cancers. PA also helps maintain a healthy weight, improves mental health by reducing symptoms of depression and anxiety, and enhances cognitive function and sleep quality (World Health Organization, 2022).

During the COVID-19 pandemic, the lockdown has intensely affected many people who regularly engage in fitness activities, particularly social interaction (Alshammari et al., 2024). However, studies show that PA is essential during the pandemic-induced lockdown as it improves immune function in chronic systemic inflammation and various diseases after COVID-19 vaccination (Silveira et al., 2021; Simpson et al., 2020). As such, monitoring PA during this critical period is of utmost importance.

### *COVID-19 Pandemic Waves in Vietnam*

Vietnam has encountered four successive surges of the COVID-19 pandemic since the start of 2020 (Minh et al., 2021). The initial surge began on January 23, 2020, and persisted for 85 days until April 16, 2020, encompassing 100 community infection cases (Minh et al., 2021). Starting on April 1, 2020, social distancing measures were implemented nationwide for 15 days (An, 2020). The rigorous epidemic management measures produced favourable outcomes, with no local transmission reported in the country from mid-April to mid-June 2020 (Thoa, 2020).

The second wave, spanning 129 days from July 25 to December 1, 2020, consisted of 554 community cases of infection in Da Nang. This wave involved the same viral strain as the first wave (Minh et al., 2021).

The third wave of COVID-19, lasting 57 days from January 28 to March 25, 2021, occurred in Hai Duong province, resulting in 910 community cases (Minh et al., 2021). Despite the occurrence of numerous diseases, the majority of those afflicted were young and in good health. As a result, there were a limited number of severe instances and no recorded fatalities (Minh et al., 2021).

The fourth wave significantly transformed the situation from April 27 to

September 2021 (Minh et al., 2021). A novel cluster surfaced at the National Hospital of Tropical Diseases, with 42 confirmed cases documented on May 6, extending to 15 provinces (Linh, 2021; Binh, 2021). Ho Chi Minh City enforced a nocturnal curfew starting at 6:00 pm on July 26, 2021. This measure restricts citizens from exiting the city and permits only emergency services to remain operational (Mai & Le, 2021). This wave in Vietnam was characterised by its complexity and danger, resulting in the highest documented death toll. The thousands of community cases heavily strained the entire healthcare system. Vietnam has recorded 601,349 COVID-19 cases and 15,018 fatalities as of September 12, 2021. The case fatality rate was 2.50%, above the global average of 2.06% (Minh et al., 2021).

### *COVID-19 Impact on Physical Activities*

The pandemic resulted in a considerable decline in overall PA levels across various population groups, significantly affecting public health. The global decrease in mild, moderate, vigorous, and overall PA is documented worldwide (Oliveira et al., 2022; Park et al., 2022; Tison et al., 2022; Wunsch et al., 2022). The decline can be attributed mainly to lockdown implementations, social distancing protocols, and the shutdown of fitness centres and recreational facilities. These measures have interrupted regular exercise regimens and restricted PA options (Do et al., 2022; Neville et al., 2022). Moreover, the rise in sedentary behaviours, such as extended periods of sitting, excessive screen time, and greater use of social media, worsened the decrease in PA (Rossi et al., 2021). Do et al. (2022) conducted a systematic review and found an overall reduction in youth PA and the significant impact of school closures on youth PA levels.

The reductions were observed across different types of PA, like walking, moderate, vigorous, and total activity levels (López-Valenciano et al., 2021). Device-based measures consistently showed declines in PA, though some self-report studies had mixed findings (Wunsch et al., 2022). Decreases were more pronounced for higher-intensity activities and outdoor sport or exercise participation due to facility closures and social distancing requirements (Neville et al., 2022; Yomoda & Kurita, 2021). Several reviews noted more considerable reductions in PA among specific subgroups, including older children/adolescents versus younger children, those from lower socioeconomic backgrounds, living in apartments/urban areas versus houses/rural areas, and females compared to males (Rossi et al., 2021; Wunsch et al., 2022; Yomoda & Kurita, 2021). In contrast, some studies found increased recreational outdoor activities like using parks/trails among specific populations during the pandemic (Park et al., 2022). However, the overwhelming evidence indicates that PA declined while sedentary behaviour increased for most groups across different countries and regions during the COVID-19 lockdowns and restrictions (Wilke et al., 2022). The specific genre of sport performed played a pivotal role in determining the magnitude of influence on PA levels during the epidemic. Team sports have significantly decreased in popularity due to limitations on group activities and the closure of sports facilities, often characterised by close physical contact and big gatherings (Yomoda & Kurita, 2021; Rossi et al., 2021).

Conversely, individual sports such as running, cycling, and home workouts were more popular due to their fair ease of exercise in compliance with social distancing regulations (López-Valenciano et al., 2021; Neville et al., 2022). These activities were flexible and easily exercised so people could maintain PA to enhance and protect their physical health during the pandemic (Park et al., 2022). During the pandemic, digital

solutions such as joining online exercise classes and using workout apps were crucial in ensuring PA maintenance (López-Valenciano et al., 2021; Neville et al., 2022). These digital technologies brought simple and available opportunities for individuals to participate in PA without leaving their homes. In addition, remote participation in online exercise sessions created favourable circumstances for social connection and motivation, minimising the impact of physical isolation due to social distancing regulations (López-Valenciano et al., 2021).

Furthermore, exercise apps provide customised training programs and progress tracking, enabling individuals to follow their fitness goals (Neville et al., 2022). The increasing adoption of digital intervention measures has emphasised the potential of technology in enhancing PA and the importance of developing user-friendly and attractive digital exercise solutions to enhance community health during and after the pandemic (Park et al., 2022).

The COVID-19 pandemic has significantly decreased PA levels among various population groups: children, youngsters, adults and elders. The PA reduction is primarily due to lockdowns, social distancing protocols, and the closure of fitness centres and recreational facilities. PA levels have declined across different activities, which is more reduction in higher-intensity activities and outdoor sports. The shift from group activities to solitary activities has also been observed, with individuals opting for individual activities like jogging, cycling, and home-based exercises. Digital interventions have become crucial in ensuring the continuation of PA, with online fitness classes and workout applications providing easy access to PA.

Reflecting on these findings from the literature, it becomes evident that while there is a wealth of data on global shifts in PA due to COVID-19, specific insights into how these shifts have played out within the Vietnamese context are sparse. The government of Vietnam implemented various policies, including social distancing and restricting economic activities, to prevent the epidemics from spreading (An, 2020; Mai & Le, 2021).

As such, this study aimed to investigate the effect of the COVID-19 pandemic on the PA of Vietnamese people with the following objectives: i) to delineate the changes in PA patterns among Vietnamese before and during the COVID-19 pandemic, ii) to investigate the types of PA adaptations preferred in Vietnam during the pandemic, and iii) to explore how socioeconomic status influences PA during the pandemic in Vietnam. This study is designed to provide empirical support to the impact of the COVID-19 pandemic on PA in Vietnam. By employing quantitative survey data, this research aims to offer insights into the adaptive behaviours of the Vietnamese population in maintaining physical health during prolonged periods of social restrictions.

## Methodology

### *Study Design*

This study used a web-based survey, considered suitable during the COVID-19 pandemic as it eliminated the risk of infection, saved time, and reduced data collection costs. By using online platforms, the research team was able to approach a wide range of communities. Some scholars have demonstrated the suitability of this approach in their studies (Choi & Bum, 2020; Katewongsa et al., 2020; Constant et al., 2020; Bourdais & Zacharakis, 2020; Corrado et al., 2020). One advantage of web-based surveys is the anonymity of participants, which helps protect their privacy and minimises researcher bias in data collection (Rhodes et al., 2003). However, online

respondents might consider unsolicited surveys an invasion of privacy (Andrews et al., 2003). Despite this, web-based surveys can appeal to specific sub-groups, such as the young and highly educated (Sheehan & Hoy, 1999; Witte et al., 2000).

### *Development of the Data-Gathering Tool*

The questionnaires in this study were developed following the survey design stages proposed by Iarossi (2006). The first knowledge base period involved reviewing literature and research methods from existing investigations on COVID-19's impact on daily life and PA habits. After acquiring basic knowledge about the research field, a draft questionnaire was constructed in the first week of February 2021.

During the second experts' consultancy period, the research team consulted with sport experts and reviewed scholarly resources to gain deeper insights. The team examined the potential effects of the pandemic based on experts' experiences with the two previous COVID-19 waves.

In the third pilot period, from February 6 to 10, 2021, 25 people practising sports were tested on a trial version of the questionnaires. The testing aimed to evaluate the questionnaire's wording and discover additional variables. Based on the feedback from these small groups, modifications were made to better align the questionnaires with the research objectives.

The final version of the questionnaire was released online on February 13, 2021, during the Third Wave of the COVID-19 pandemic in Vietnam. At that time, provinces such as Quang Ninh, Hai Duong, Hanoi, and Ho Chi Minh City were under high pressure from the pandemic. Hai Duong implemented province-wide social distancing, while Ho Chi Minh blocked some areas where COVID-19-positive cases were reported. Hanoi ordered the closure of non-essential activities from February 2, 2021, to March 23, 2021.

The survey concluded on April 1, 2021, when several provinces lifted social distancing regulations. Hai Duong province, the most severely affected by the Third Wave, announced the end of its social distancing state and transitioned to a new normal situation. Major cities, namely Hanoi and Ho Chi Minh City, returned to regular operations a week earlier. The data collection generated 1,428 respondents; however, after cleaning the data, the final number of respondents totalled 627.

The questionnaire has three main parts: The first part includes demographic information of the respondents (age, sex, marital status, education, occupation, and income). The second part assessed the respondents' physical exercise habits before and during COVID-19 regarding PA frequency, measured by the number of days spent on PA, sport type, and participation modes. PA levels were reported in two stages: before and during the pandemic. To further examine differences in PA before and at the start of the COVID-19 crisis, we applied the classification of Mutz & Gerke (2020), generating four groups based on their levels of PA: (1) *inactive individuals*, (2) *reducers*, (3) *maintainers*, and (4) *intensifiers*. '*Inactive individuals*' did not participate in PA before and during the pandemic. '*Reducers*' have regularly participated in PA but significantly reduced their activities at the pandemic's start. '*Maintainers*' are respondents whose PA levels have remained as high as in the pre-pandemic period. '*Intensifiers*' have participated in more PA during the pandemic than before. Furthermore, the proportions of '*reducers*', '*maintainers*' and '*intensifiers*' were also analysed separately according to *age*, *gender*, *education level*, *marital status*, *income*, and *occupation*.

The authors carefully read all responses and developed a coding scheme for the three main groups of responses: (a) assertions

about PA that the respondent reduced or skipped during the pandemic; (b) assertions of activities that the respondent institutes, maintains or increases; and (c) assertions regarding specific contextual reasons and conditions for adaptation to PA. The responses were then coded according to the coding scheme ($\kappa = 0.77$), thus dividing the responses into 26 (sub)categories. After correcting the coding disagreements, the percentage of respondents with an open answer matched a particular response category was calculated, and the most prominent categories were identified. Therefore, one answer can fit multiple categories.

### *Ethical Considerations*

This study was conducted with a commitment to upholding ethical standards and principles similar to those outlined in the Declaration of Helsinki, even though it did not undergo a formal review by an institutional review board. To ensure ethical conduct, all participants were provided comprehensive information about the study's purposes, procedures, potential risks, and benefits. They provided informed consent, acknowledging their understanding and right to withdraw from the study at any time without consequences. All collected data were anonymous to protect participant privacy and confidentiality. In addition, access to the data was restricted to the research team.

### *Study Hypotheses*

In examining the impact of the COVID-19 pandemic on PA levels in Vietnam, this study applied general hypotheses proposed by Turhan (2020). In particular, two hypotheses for this study are developed as follows:

Hypothesis H0: There was no significant change in Vietnamese people's PA levels before and during the COVID-19 pandemic. This hypothesis assumes that restrictions related to the pandemic did not change the frequency or intensity of PA among studied participants.

Hypothesis H1: There was a significant change in PA levels of Vietnamese people before and during the COVID-19 pandemic. This alternative hypothesis implies that physical restrictions imposed during the pandemic, such as lockdowns and social distancing policies, significantly impacted the frequency or intensity of PA.

These hypotheses were tested using data collected through an online survey, focusing on various dimensions of PA, including type, frequency, and duration, before and during the pandemic. The chi-square test of independence was utilised to examine the correlation between demographic characteristics and changes in PA levels, thereby providing insights into how different population segments adjusted their PA behaviours in response to the pandemic.

## Results

Table 1 shows the characteristics of the 627 respondents. Over half of respondents are under 25; the group of 36-45 accounts for the smallest fraction (20.1%). There are 339 female respondents, making up 54.07% of the survey population, and 288 male respondents, making up 45.93%. Stratified by marital status, 67.3% of participants are single, while 32.7% are married. Regarding respondents' education level, the vast proportion (83.73%) are at the undergraduate level or below; the rest hold master's degrees or higher qualifications. Roughly 51% of respondents are employed, and 36.9% are non-working. In terms of the respondent's income, the monthly income is divided into three categories: 'No income', 'Under VND 15 million', and 'VND 15 million and above', in which the percentage of 'Under VND 15 million' is the largest, over 51%. Most respondents live in Hanoi (305

respondents) and Ho Chi Minh City (160 respondents), making up 48.64% and 25.52% of the total respondents, respectively.

*Table 1.* Demographic characteristics of respondents (n = 627)

| Characteristic | | Number of respondents | Percentage |
|---|---|---|---|
| Age | Under 25 | 327 | 52.15 |
| | 26 - 35 | 174 | 27.75 |
| | 36 - 45 | 126 | 20.10 |
| Gender | Male | 288 | 45.93 |
| | Female | 339 | 54.07 |
| Marital Status | Single | 422 | 67.30 |
| | Married | 205 | 32.70 |
| Education Level | Bachelor's & under | 525 | 83.73 |
| | Master's & above | 102 | 16.27 |
| Occupation | Non-working | 231 | 36.90 |
| | Self-employed | 74 | 11.82 |
| | Employed | 321 | 51.28 |
| Monthly income | No income | 138 | 22.08 |
| | Under 15mil | 322 | 51.52 |
| | 15mil and above | 165 | 26.40 |
| Location | Hanoi City | 305 | 48.64 |
| | Ho Chi Minh City | 160 | 25.52 |
| | Others | 162 | 25.84 |

The study results indicate a slight increase in PA during COVID-19 compared to the pre-pandemic period ($\chi 2 = 757.0725$; df = 7; p = 0). Figure 1 shows that overall, Vietnamese people adjusted their time spent on PA during the pandemic. Most notably, the percentage of people who increased their PA more than six days a week increased by 2.4%, from 6.1% before the pandemic to 8.5% during the pandemic. In contrast, the proportion of Vietnamese who did not participate in weekday PA changed dramatically, with a 4.5% decrease. Besides that, people who participated in PA 1 or 2 days before the pandemic remained slightly the same exercise time during the pandemic. Vietnamese people preferred doing exercises at the level of 3 days, with 25% and 26.5% before and during the pandemic, while at the level of 4-5 days a week, they had an enhancement of around 0.6% to 1%. The number of people exercising daily or seven days per week remained the same at approximately 6.7% to 6,9%.

The survey also shows that people have managed to maintain their exercise habits and have mixed reactions; some individuals even raised their time on PA (see Table 2). The percentage of Vietnamese inactive before and during the pandemic is 5.3%. The 26.8% belonged to the '*reducers*' who had slightly reduced the intensity of their time spent on PA or stopped exercising altogether. Another figure of 37.9% belonging to the '*maintainers*' represents their level of PA retention. Finally, 35.4% belonged to the

'*intensifiers*', a substantial increase in time spent on PA during the COVID-19 pandemic. Thus, while many people reduce their time spent on PA or choose to be inactive in response to containment measures, others can still maintain or increase their time spent on PA.

*Table 2.* The PA levels (%)

| PA Level | Percentage | PA Level | Percentage |
|---|---|---|---|
| Inactive | 5.3 | | |
| Active | 94.7 | Reducer | 26.8 |
| | | Maintainer | 37.9 |
| | | Intensifier | 35.4 |
| Total | 100 | | |

Table 3 features the Chi-square test results, showing that age, gender, income, and location are correlated with PA levels, with significance levels of 5%. The occupation is significantly associated with PA levels, with a significance level of 10%. Accordingly, differences in marital status and education are not revealed as determinants of changes in PA habits.

*Table 3.* Chi-square test results

| Demographic characteristics | Pearson Chi-square estimated value | P Value |
|---|---|---|
| Age | 10.2444 | 0.037 |
| Gender | 20.5829 | 0.000 |
| Marital status | 1.7834 | 0.410 |
| Education level | 1.2939 | 0.524 |
| Occupation | 7.8773 | 0.096 |
| Income | 15.1874 | 0.004 |
| Location | 14.2908 | 0.006 |

In the marital status criterion, Table 4 features no significant difference in assessing the level of regular exercise that both are concerned about doing exercises; only 5.7% of single people are inactive, while this figure for married is 4.4%. Notably, married people have a lower percentage of intensifiers than single people (31.6% and 37.2%), while the results are opposite with the group of reducers and maintainers. In addition, stratifying by education level, there is no significant difference in the group of reducers between the two levels of education. Bachelor or lower degree holders spend more time doing exercise during the epidemic, with 36.2% being intensifiers. The table also shows that the inactivity rate for non-income or non-working people is relatively high. Conversely, this rate is low for people with

incomes above 15 million or self-employed. The lowest percentage of income belongs to reducers with a level of over 15 million at about 23.5%, while in the occupation criterion, it is reducers with 22.2% of the employed.

*Table 4.* The PA levels during the pandemic, by marital status, education level, occupation, and monthly income (%)

| Demographic characteristics | | Total | Active | | | |
|---|---|---|---|---|---|---|
| | | Inactive | Active | Reducers | Maintainers | Intensifiers |
| Marital status | Single | 5.7 | 94.3 | 24.6 | 34.6 | 35.1 |
| | Married | 4.4 | 95.6 | 26.9 | 38.5 | 30.2 |
| Educational level | Bachelor & under | 5.0 | 95.0 | 25.4 | 35.2 | 34.4 |
| | Master & higher | 6.9 | 93.1 | 25.5 | 39.2 | 28.4 |
| | Non-working | 8.2 | 91.8 | 23.4 | 31.2 | 37.2 |
| Occupation | Employed | 2.7 | 97.3 | 21.6 | 48.7 | 27.0 |
| | Self-employed | 3.7 | 96.3 | 27.7 | 36.1 | 32.5 |
| | No income | 8.7 | 91.3 | 22.5 | 27.6 | 41.3 |
| Income | Under 15mil | 4.3 | 95.7 | 28.2 | 33.9 | 33.6 |
| | Over 15mil | 4.2 | 95.8 | 24.6 | 34.6 | 35.1 |

Responses to the open-ended question were content-analysed to provide multifaceted information on this issue and gain a deeper insight into Vietnamese people's adaptation to participating in PA during the COVID-19 pandemic. Table 5 shows the responses and categorisation by active, reducers, maintainers, and intensifiers. Running and martial arts are the two most popular PAs in the survey's sample. Due to COVID-19, the number of people participating in martial arts decreased the most, from 42.1% to 13,1% (down 29.0%), followed by badminton and football, with a decrease of 6.8% and 4.7%, respectively. Along with that, other creations also saw a slight reduction in the level of the active category. Contrary to the general decline trend of sports during the pandemic outbreak, yoga, gym, and indoor fitness saw a relative increase of 2.3% and 3.1%, respectively.

Table 5 also shows a decrease in almost all sports in the reducers' group. The most significant decline was in martial arts, with 42.8%. In general, running was a stable and long-term choice when the difference before and during the pandemic was ambiguous among the reducer, maintainer, and intensifier groups. The respondents tended to do home-based individual exercises such as yoga, gym, and indoor fitness. At the same

time, the maintainers and intensifiers remain the same or decrease in the sports required by the team players.

*Table 5.* Types of PA, by the change of PA levels before and during the pandemic (%)

| Types of PA | Active | | Reducers | | Maintainers | | Intensifiers | |
|---|---|---|---|---|---|---|---|---|
| | Before | During | Before | During | Before | During | Before | During |
| Football | 13.2 | 8.5 | 16.4 | 7.5 | 16.0 | 10.7 | 10.0 | 8.1 |
| Tennis | 2.7 | 2.4 | 1.9 | 1.9 | 3.6 | 3.6 | 2.9 | 1.9 |
| Basketball/ Volleyball | 6.7 | 4.5 | 8.2 | 2.5 | 8.4 | 5.8 | 4.8 | 5.2 |
| Billiards | 2.6 | 1.8 | 1.9 | 0.6 | 3.6 | 2.2 | 2.4 | 2.4 |
| Table Tennis | 3.7 | 2.9 | 4.4 | 3.8 | 4.0 | 2.7 | 3.3 | 2.9 |
| Badminton | 10.5 | 3.7 | 15.1 | 5.0 | 11.6 | 3.6 | 7.6 | 3.3 |
| Martial Arts | 42.1 | 13.1 | 54.1 | 11.3 | 48.0 | 17.3 | 33.3 | 11.9 |
| Aerobic | 5.4 | 4.3 | 3.1 | 3.1 | 4.4 | 3.6 | 9.0 | 6.7 |
| Golf | 1.1 | 0.6 | 0.6 | 0.0 | 1.3 | 0.9 | 1.4 | 1.0 |
| Bowling | 0.8 | 0.5 | 0.6 | 0.0 | 1.3 | 0.9 | 0.5 | 0.5 |
| Swimming | 10.2 | 5.9 | 10.7 | 6.3 | 12.4 | 7.6 | 9.0 | 4.8 |
| Gym & indoor fitness | 30.6 | 33.7 | 36.5 | 27.0 | 34.7 | 38.2 | 26.7 | 39.0 |
| Biking | 11.5 | 11.8 | 12.6 | 13.2 | 11.6 | 9.3 | 12.4 | 15.2 |
| Yoga | 16.7 | 19.0 | 11.3 | 10.7 | 21.8 | 22.7 | 18.1 | 24.3 |
| Running | 42.1 | 41.3 | 54.1 | 43.4 | 48.0 | 46.2 | 33.3 | 41.0 |

Table 6 presents the participation mode before and during the pandemic. According to the survey, 'group size has not changed compared to pre-epidemic' and has remained at a stable level of 17.8%. Individual exercise was at a very high level, 74.3% of the intensifier group, during the outbreak. However, before the pandemic, individual exercise was also relatively high compared to other forms of exercise; it was similar to the findings in Table 3; in particular, individual sports such as running, martial arts, gyms, and indoor fitness had a high proportion of people exercising. On the other hand, results show that Vietnamese people do not like

group exercises (i.e., done in groups of 2 people, 3-6 people, over six people) before or after the pandemic. Under the group exercise, the number of reducers was low before and during the pandemic. Two-person PA is the most preferred form of group training compared to the other forms during the pandemic. Practising in small groups via video call sessions attracted only a few people.

*Table 6.* The PA participation mode by the PA levels (%)

| Participation mode | Before the pandemic | | | During the pandemic | | |
|---|---|---|---|---|---|---|
| | Reducer | Maintainer | Intensifier | Reducer | Maintainer | Intensifier |
| Total no physical activities | 0.0 | 0.0 | 21.0 | 10.1 | 0.0 | 0.0 |
| Unchanged group size compared to the pre-pandemic period | - | - | - | 10.7 | 17.8 | 10.5 |
| Individual exercise | 46.5 | 59.1 | 53.3 | 56.6 | 68.9 | 74.3 |
| Two-person physical activities | 15.7 | 7.6 | 6.7 | 13.2 | 4.0 | 8.1 |
| Small group physical activities via video calls | - | - | - | 0.6 | 0.0 | 0.0 |
| Online mode physical activities (learning via online channels, joining challenge contests, etc.) | 21.4 | 18.2 | 9.5 | 2.5 | 5.8 | 1.9 |
| Self-exercising and submitting track log to a private group | 0.6 | 0.0 | 0.0 | - | - | - |
| Small group size (3-6 people) | - | - | - | 0.0 | 0.4 | 0.0 |
| Big group size (over 6 people) | 15.7 | 15.1 | 9.5 | 6.3 | 3.1 | 5.2 |

The supplementary material shows why people practised physical exercises during the pandemic. When asked, 'What are the reasons for your self-consciousness to change your practice habits?' Improving personal health is the reason people care most, with 74.9%, followed by reasons about 'regulation to wear proper masks, keep a safe distance, wash hands with sanitisers' and 'your job and income'. The most surprising thing is that the reason 'When exercising, the risk for COVID-19 infection increases' is not the reason people care the most; in other words, it seems that Vietnamese people changed their habits based on different factors such as government regulation, mass media, community judgement or their business income. Apart from that, many people believe that their participation in PA is greatly influenced by government regulations, sports teams, family members, and mass media.

The questions examining the conditions of practising PA during the pandemic revealed that a high proportion of respondents were concerned about the government's regulations. Specifically, the 'crowd gathering ban regulations' and 'wearing masks and hand sanitisers' influenced their decision to practice sports. These concerns outweighed other reasons such as 'no exercise equipment at home', 'closed gyms', or 'closed public parks and gardens.' Both 'no exercise equipment at home' and 'too small space at home' contributed to over 50% of the reducer group. The 'No online exercising guidelines' factor always had the lowest percentage in all three groups: reducer, maintainer, and intensifier, accounting for one-fifth to one-third of respondents. In other words, many Vietnamese people adapted to physical exercise with online exercising guidelines during the pandemic; unavailable guidelines also affected their practices.

## Discussion

This study aimed to investigate the impact of the COVID-19 pandemic on PA levels and patterns among Vietnamese individuals, exploring their adaptations and the influence of socioeconomic factors. It also provided insights relevant to informing public health policies and interventions in the context of similar health crises.

The findings of this study indicated that the COVID-19 pandemic had significantly impacted the PA levels of Vietnamese people, therefore rejecting hypothesis H0 and supporting hypothesis H1. This is pertinent to the global trend reported in nations where pandemic-related constraints and lifestyle changes have impacted exercise patterns (Bourdas & Zacharakis, 2020; Constandt et al., 2020; Mutz & Gerke, 2020). The three main objectives discussed are as follows:

### *1. Changes in PA patterns among Vietnamese individuals before and during the COVID-19 pandemic*

The study reveals significant changes in the PA patterns of Vietnamese people during the COVID-19 pandemic. While a significant portion (26.8%) encountered a decrease in their PA levels, a considerable percentage (35.4%) made efforts to increase their PA engagement. This observation underscores the resilience and flexibility displayed by individuals in upholding their exercise routines in the face of the obstacles brought about by the pandemic. Furthermore, the data indicates a slight overall increase in PA levels during the pandemic, contrary to the global decrease in PA (Mutz & Gerke, 2020). This new observation can be attributed to Vietnam's effective pandemic response strategies, such as a policy to enable safer participation in outdoor exercise activities that could be valuable during the pandemic.

### *2. Types of PA adaptations preferred in Vietnam during the pandemic*

The study's findings reveal specific PA adaptation methods employed by the Vietnamese during the pandemic. In line with global trends (Kaur et al., 2020; Schnitzer et al., 2020), there was a significant increase in home exercises and digital PA platforms. Activities such as yoga and indoor workouts are increasingly popular, reflecting a shift towards solitary and indoor habits. Meanwhile, team sports and activities requiring infrastructure or equipment, such as martial arts, badminton, and soccer, had significantly declined. These observations align with the limitations imposed by social distancing measures and the closure of public facilities. Furthermore, the study emphasises the appearance of new forms of PA, such as small group practices through online guidance and self-reporting progress for virtual communities. This adjustment highlights the method that Vietnamese individuals employ to maintain PA while adhering to public health guidelines.

### *3. Impact of socioeconomic status on PA during the pandemic in Vietnam*

The study results show that socioeconomic factors played an essential role in shaping PA behaviours during the pandemic in Vietnam. People with higher incomes were likelier to maintain or increase their PA levels, possibly due to greater access to online resources and separate spaces for exercising at home.

Conversely, lower-income groups faced significantly more challenges in maintaining their PA routines, which reflected disparities in access to resources and personal space, particularly in urban areas. These socioeconomic disparities are aligned with global observations (Corrado et al., 2020). However, their expressions were particularly transparent in the Vietnamese context due to the high urban density and the limitations in accessing the personal space of many households. This finding emphasises the need for targeted policies and interventions to address socioeconomic inequalities in promoting and creating favourable conditions for PA during public health emergencies. By addressing these research objectives, this study provides comprehensive insights into the changes in the PA models, suitable adaptations, and the impact of socioeconomic factors on exercise behaviour among the Vietnamese during the COVID-19 pandemic. These findings enhance global understanding of the pandemic's impact on PA and provide implications for public health policies and interventions related to PA in Vietnam.

## Conclusion and Recommendations

Amid the rapid spread of COVID-19, which has significantly impacted all aspects of daily life, including PA, this small-scale online study reveals positive findings in Vietnam. According to survey results, most respondents continued to exercise during the COVID-19 outbreaks. Many active individuals, whether reducers, maintainers, or intensifiers, viewed PA as essential to improve health. This aligns with Katewongsa et al. (2020), who stated that PA can enhance the immune systems and reduce stress throughout the pandemic.

The findings reveal that survey participants adapted well to the challenges posed by the epidemic. The COVID-19 outbreaks and the government's policy responses interrupted and made sports participation challenging. A remarkable decrease in playing sports requiring social gatherings and specialised infrastructure and equipment, such as football, badminton, and martial arts, was observed. However, people maintain their sports habits by switching to other sports or doing different forms of exercise that are more suitable for this situation. In particular, the number of respondents doing yoga and gym and indoor

fitness increased sharply between the two stages of COVID-19. This result aligns with the study of Schnitzer et al. (2020), showing that many participants intensified home training instead of the practices of outdoor sports. Most respondents preferred individual training during the pandemic.

New forms of PA emerged, such as practising in small groups via video call and self-practising tracklogs to 10-person groups. Good compliance with regulations was a critical factor in maintaining exercise routines. Most people agreed that following the regulations on wearing masks, keeping distance, and sanitising hands is necessary, resulting in some concerns over being infected during exercise.

Despite its contributions to the knowledge base on PA during the pandemic, this study acknowledges its limitations. First, relying on self-reported data from an online survey may introduce bias, as responses can be influenced by individuals' perceptions or willingness to report accurately. Second, the survey's sample size and demographic reach may not fully represent the Vietnamese population, mainly rural or lower-income groups with less access to online platforms. Third, the study's cross-sectional design prevents inferring causality between observed behaviours and specific pandemic-related measures.

Future research should address these limitations by employing longitudinal study designs that can better track changes in PA over time and assess the causal impacts of specific public health measures during an emergency health crisis, such as the COVID-19 pandemic. In addition, other future research with larger sample sizes and wide ranges in terms of background, such as ethnicity, type of work, and location, would provide better findings. Ultimately, research with wearable devices could provide more real-time insights into PA behaviours.

In conclusion, the present study sheds light on the resilience and adaptability exhibited by Vietnamese individuals in upholding their levels of PA during the COVID-19 pandemic. It also underscores their capacity to confront obstacles and discover alternative methods to remain physically active despite the disruptions resulting from the crisis. Nevertheless, it highlights the importance of the ongoing investigation to comprehend the lasting impacts of global emergencies on public health habits. This comprehension is essential for formulating efficient interventions that advocate for and enhance PA, especially during periods of crisis. Decision-makers ought to consider these findings when formulating strategies that promote PA in a manner that is not only culturally sensitive but also adjustable to the distinct circumstances of the populace during emergencies. By integrating these perceptions into public health initiatives, policymakers can more effectively assist individuals in maintaining healthy behaviours in the face of unprecedented challenges such as the COVID-19 pandemic.

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## Supplementary Material

Factors affecting respondents' decision to exercise (%)

| Items | Statements | Total | Active | Inactive | Reducer | Maintainer | Intensifier |
|---|---|---|---|---|---|---|---|
| Reason | The more intense the pandemic is, the more the physical activities should be to enhance personal health | 74.9 | 73.7 | 56.7 | 64.8 | 76.4 | 77.6 |
| | When exercising, people need to wear proper masks, keep safe distance, wash hands with sanitisers | 71.4 | 70.2 | 70.0 | 67.9 | 72.4 | 69.5 |
| | When exercising, the risk for Covid-19 infection increases | 17.5 | 17.5 | 33.3 | 16.4 | 22.2 | 13.3 |
| | When exercising, your business may be affected if you are infected with the Covid-19 | 55.7 | 55.1 | 60.0 | 65.4 | 53.3 | 49.0 |
| | When exercising, your job and income may be affected if you are infected with the Covid-19 | 57.1 | 56.4 | 53.3 | 65.4 | 54.2 | 51.9 |
| | When exercising, your information may be spread on mass media if you are infected with the Covid-19 | 51.8 | 50.8 | 53.3 | 55.3 | 52.4 | 45.7 |
| | When exercising, you may be judged by the community if you are infected with the Covid-19 | 46.1 | 46.0 | 46.7 | 52.8 | 44.0 | 42.9 |
| Effect | Family influence | 31.4 | 31.0 | 23.3 | 32.7 | 29.3 | 31.4 |
| | Exercise peer influence | 33.4 | 32.7 | 30.0 | 34.0 | 32.0 | 32.4 |
| | Coach influence | 20.3 | 20.5 | 13.3 | 21.4 | 21.3 | 19.0 |
| | Closed community on social networks | 23.7 | 23.9 | 30.0 | 18.9 | 22.2 | 29.5 |
| | Open community on social networks | 31.1 | 30.6 | 30.0 | 26.4 | 28.9 | 35.7 |
| | Office coworker or leader influence | 20.3 | 21.4 | 10.0 | 21.4 | 20.9 | 21.9 |
| | Government regulation influence | 35.9 | 35.5 | 23.3 | 44.7 | 34.7 | 29.5 |
| | Mass media influence | 29.7 | 29.6 | 16.7 | 28.9 | 30.2 | 29.5 |
| | Commercial ads influence | 19.6 | 19.7 | 6.7 | 20.8 | 19.1 | 19.5 |
| | KOL, streamer, youtuber influence | 25.8 | 25.8 | 16.7 | 20.1 | 27.6 | 28.1 |
| Condition | Regulation related to wearing masks and hand sanitisers | 57.4 | 56.4 | 26.7 | 57.9 | 60.0 | 51.4 |
| | Crowd gathering ban regulations | 69.3 | 68.5 | 56.7 | 76.7 | 68.4 | 62.4 |
| | Travel distance to parks and gardens | 44.9 | 44.3 | 26.7 | 48.4 | 43.1 | 42.4 |
| | No exercise equipment at home | 36.0 | 36.0 | 50.0 | 40.3 | 34.7 | 34.3 |
| | Too small space at home | 31.8 | 32.0 | 53.3 | 39.0 | 31.6 | 27.1 |
| | No online exercising guidelines | 21.7 | 21.2 | 30.0 | 22.6 | 20.9 | 20.5 |
| | Closed gyms | 36.0 | 35.7 | 40.0 | 44.7 | 36.9 | 27.6 |
| | Closed public parks and gardens | 35.2 | 34.7 | 43.3 | 42.1 | 33.3 | 30.5 |