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RESEARCH **Open Access**

Do Virtual Race Events Improve Physical Activity Behavior?

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Abstract
Physical inactivity remains a major global health concern, with approximately one in four adults not meeting recommended activity levels. Virtual competitions have emerged as an alternative approach to encourage physical activity, especially following the COVID-19 pandemic. This study aimed to evaluate the impact of a virtual race event on physical activity behavior in adults with a sedentary lifestyle. A cohort study was conducted involving 68 participants, of whom 32 completed both pre- and post-event assessments. Physical activity levels were measured using the Global Physical Activity Questionnaire (GPAQ) before and four weeks after the virtual race. Participants were categorized into a sedentary group (<600 MET-minutes/week) and an active group (≥600 MET-minutes/week) based on baseline data. The McNemar test was used to assess changes in physical activity classification. Results showed that in the sedentary group, the number of active participants increased from 0 to 5 (41.67%), while in the active group, the number of participants who remained active decreased from 20 to 13 (65%). However, the difference between the groups was not statistically significant ($p = 0.56$). These findings suggest that while virtual race events may offer motivational value, their short-term effect on physical activity behavior may be limited without additional support mechanisms. Future studies should consider larger samples, longer follow-up periods, and the integration of behavioral strategies to enhance engagement and promote sustained physical activity, especially among previously inactive populations.

Keywords: Cycling, Exercise Psychology, GPAQ, MET, Sport Event.

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1. INTRODUCTION

Regular physical activity is important for maintaining good health and reducing the risk of chronic diseases, such as heart disease, stroke, diabetes, and some cancers (Physical Activity Guidelines Advisory Committee, 2018). However, physical inactivity remains a major public health issue worldwide, with approximately one in four adults not meeting the recommended levels of physical activity (WHO, 2022). Physical inactivity or a sedentary lifestyle can affect health, the environment, economic growth, community welfare, and quality of life (Hao et al., 2024). It is associated with increased cardiovascular risk, reduced physical function, worsened mental health symptoms, and premature mortality (Lavie et al., 2019). Promoting physical activity is therefore a global health priority and part of the 2030 Sustainable Development Goals (WHO, 2018). To address this issue, various strategies have been introduced, including sports clubs, fitness apps, public health campaigns, following sports video movements, and participating in sports competitions (Wiium & Säfvenbom, 2019).

In recent years, particularly during the COVID-19 pandemic, virtual events such as online running and cycling races gained popularity as a means of staying active during lockdowns (Dening, 2016; Miller, 2019; Westmattelmann et al., 2021). A virtual race is a race that can be entered in any location, at the pace of the participants, outdoors or on a treadmill, alone, or with a group of friends (Gone For a Run Organization, 2021). Virtual events offer the flexibility and convenience of participating in physical activities from home or any location while virtually connecting with other participants. Moreover, virtual events allow participants to track and monitor their physical activity using wearable devices or mobile applications, which motivate them to remain physically active (Arazi & Taati, 2025; Wang et al., 2016; Wattanapisit et al., 2020).

Before the pandemic, participation in traditional in-person physical activity events was dominant, while virtual formats were rarely used. However, during the COVID-19 pandemic, a significant shift occurred: studies reported increased participation in virtual events, with some surveys showing up to 40–60% of previously inactive individuals engaged in physical activity through virtual platforms, compared to much lower engagement in non-virtual settings during lockdowns. This shift reflects how virtual events filled the gap when access to gyms, parks, and organized sports was restricted (Arazi & Taati, 2025; Byrne, Parente, & Yedlinsky, 2022; Newbold, Rudnicka, & Cox, 2021).

Despite the growing popularity of virtual events, their effectiveness in promoting physical activity behavioral changes is not yet fully understood. Although some studies using wearable devices or smartphone technology have reported positive outcomes, such as increased physical activity levels and improved health outcomes (Bort-Roig et al., 2014; Coughlin & Stewart, 2016), studies on virtual races are scarce.

Existing literature has largely focused on structured online fitness programs or workplace interventions, leaving a gap in understanding the behavioral impact of low-cost, community-based virtual competitions. This study aims to address a gap in the current literature by evaluating the short-term impact of incidental virtual sports competitions on physical activity behavior, particularly among individuals with a sedentary lifestyle. Specifically, the study examines whether participation in a one-time virtual cycling race can lead to measurable changes in physical activity levels over a four-week period following the event. By comparing pre- and post-event activity levels using the Global Physical Activity Questionnaire (GPAQ)(Cleland et al., 2014; Keating et al., 2019), this study seeks to explore the potential of virtual competitions as a behavioral intervention to increase and sustain physical activity engagement in real-world, low-structure settings.

2. RESEARCH METHOD

The study design of this research was a cohort study with multiple observations. A virtual race through a sports event-virtual ride using a bicycle, was offered to community-dwelling healthy adult men and women. The participants could join the race at any location and at their own convenience, outdoors. The outcomes of the sedentary group (SG) were compared with those of the active control group (AG). Comparing a sedentary group with an active group allows for a direct assessment of the impact of virtual sports competitions on physical activity levels. By including both groups, the study can evaluate whether participation in virtual sports competitions leads to increased physical activity compared to maintaining a sedentary lifestyle.

Comparing participants with non-participants would not provide a clear understanding of the specific effects of virtual sports competitions, as other factors could influence physical activity levels in non-participants. Additionally, recruiting only sedentary adults and conducting a one-arm pre-post study design would limit the ability to attribute any observed changes solely to the virtual sports competition, as other factors or interventions could influence the outcomes. Comparing a sedentary group with an active group allows for better control and interpretation of the results, providing insights into the effectiveness of virtual sports competitions in promoting physical activity. The participants were asked to complete The GPAQ (Armstrong & Bull, 2006; Misra et al., 2014), with the proportion of metabolic equivalents of task (MET) changes being the main output. The results of the GPAQ before the race event and 4 weeks after the event were compared to determine whether the races had potential benefits in increasing physical activity.

The participants in this research were healthy male or female adults aged 18 years and older who were eligible to participate in this study. The inclusion criteria included being free from known cardiovascular disease or mobility impairments and the willingness to participate in a virtual race and complete the required questionnaires before and four weeks after the event. The exclusion criteria were having cardiovascular disease and mobility disabilities. The drop-out criteria were termination of information for two consecutive weeks and withdrawal from the study. A total of 68 virtual race participants provided informed consent to participate in the study. The participants were recruited through voluntary registration, and no formal sample size calculation was performed, as this was an exploratory or pilot study based on event feasibility and available participants. Of the 68 who enrolled, 32 participants completed both the pre- and post-event assessments and were included in the final analysis. Participants were allocated into two groups based on their physical activity levels as measured by the Global Physical Activity Questionnaire (GPAQ) prior to the event. Those who scored ≥600 MET (minutes/week) were categorized into the active group (AG), while those with <600 MET were placed into the sedentary group (SG).

Statistical Analysis used descriptive statistics were used to summarize participant characteristics, including age, sex, weight, height, and body mass index. To evaluate changes in physical activity levels before and four weeks after the virtual race event, the McNemar test was used, a nonparametric statistical test suitable for paired categorical data. This test was applied to assess the differences in the proportion of participants categorized as active (≥600 MET-minutes/week) or sedentary (<600 MET-minutes/week) in both the sedentary group and active group. The Statistical Package for the Social Sciences (SPSS, version 26.0; IBM Corp., Armonk, NY, USA) was used for all statistical analyses. A p-value ≤ 0.05 was considered statistically significant. This study was approved by the Health Research Ethics Committee of Cibabat General Hospital (Ethical Clearance No: 070/011/Ethical Clearance/RSUD-CBBT/X/2021) and was conducted in accordance with the Declaration of Helsinki. All participants were fully informed about the study procedures before written informed consent was obtained.

3. RESULTS AND DISCUSSION

Among the 68 participants, only 32 participants who completed the questionnaire were included in the final analysis. Overall, 20 participants were allocated to the AG, and 12 participants were allocated to the SG. The baseline characteristics of the study participants are presented in Table 1. The mean, median, and range age of the 32 participants was 38.4 ± 11.5 years, 36 years, and 24–74 years. The participants in the SG and AG were aged 24–74 years and 27-47 years, respectively. The AG involved predominantly male participants (60%), while the SG involved predominantly female participants (67%).

Table 1. Baseline participant characteristics by group.

Characteristics	**AG (n=20)**	**SG (n=12)**	**p-value***
Age (years)	40.9 ± 13.1	34.4 ± 6.7	0.13
Height (cm)	162.9 ± 9.6	161 ± 9.6	0.60
Weight (kg)	67.7 ± 16.7	64.9 ± 12.4	0.60
BMI (kg/m^2)	25.2 ± 4.3	24.9 ± 3.1	0.82
Pre-event MET	2698 ± 2203.6	225 ± 218.9	<0.001
Male	12	4	0.14#
Female	8	8	

Description: **Unpaired T-test for normally distributed data and Mann-Whitney U test non-normally distributed data. #Fisher exact test was used to compare gender between groups. Data are presented as the mean ± SD, except for the sexes that are presented as frequency. AG: active control group; SG: sedentary group; BMI: body mass index.*

Table 1 presents the MET changes from before the event to 1 month after the virtual race event in the SG and AG. As shown in the figure, there are several outliers in the data.

Table 2. Proportion of MET changes at the 4th week after the event.

	Sedentary (<600 MET) at the 4th week (%)	Active (≥600 MET) at the 4th week (%)	p-value*
Sedentary group	7 (58.33)	5 (41.67)	0.56
Active group	7 (35.00)	13 (65.00)	

**McNemar test*

As shown in Table 2, 65% of the AG participants remained active in the fourth week after the event, whereas in the SG, only 41.67% of the respondents turned active, showing a higher percentage of participants that remained active in the AG. Although there was a decrease in the number of active categories in the AG (from 20 participants to 13 participants) in the fourth week after the event and an increase in the number of active categories in the SG (from 0 participants to 5 participants), no significant difference (p=0.56) was observed.

In the current study, several participants, both in the SG and AG, experienced a change in the MET category 4 weeks after the event. Initially, none of the participants (n=0) in the SG were categorized as active, but at 4 weeks after the event, 5 (41.7%) participants became active. Furthermore, the data showed a decrease in the number of AG participants (-35%) who were physically active, as evidenced by the MET calculations obtained from the GPAQ questionnaire. These results suggest that a virtual race event may increase or change the behavior toward physical activity in sedentary individuals, especially in the first month. To the best of our knowledge, this study is the first to investigate the effect of virtual race events on physical activity behaviors, using the GPAQ.

Despite the decrease in physical inactivity, no significant increase was observed, in contrast with the findings of Bowles et al. (2006) who found a significant increase ($p< 0.0001$) in the average number of bicycle riding sessions a month after a mass community cycling event. Their study involved individuals aged ≥16 years (n=918), and 83% rated themselves as competent or regular cyclists. In addition, the event was not a virtual race, as in the present study. Our finding regarding the MET value is also contradictory with the findings by Damayanti and Ismail (2021) who investigated the effect of 1-month virtual community physical activity on students' physical activity during the COVID-19 pandemic using a one-group pretest-posttest design. They found a significant increase ($p<0.05$) in the MET value compared with baseline after 1 month of intervention. The significant increase in their study might be due to the accompaniment of the high- intensity physical activity program (4–6 times/week). These studies often included higher-intensity interventions, ongoing coaching, or group-based components, which may have contributed to their stronger outcomes. This suggests that virtual race events alone may not be sufficient to induce meaningful behavioral change without complementary strategies such as social support, goal-setting, or feedback mechanisms. In the present study, there were no additional measures to maintain a high physical activity among the participants. Further, physical activity was only measured using the questionnaire before and 1 month after the virtual race event. The reason for measuring physical activity through questionnaires lies in their cost-effectiveness and practical advantages for large-scale studies, alongside their ability to capture a broad range of activity types and contextual information.

Another study conducted qualitative interviews with 14 individuals who engaged in two types of physical activity: running and working (Early & Corcoran, 2013). They found that such exercise events could encourage people with low activity levels by increasing their positive experiences. Virtual races vary widely with respect to design and implementation, which can affect their effectiveness in promoting physical activity. For example, virtual races may provide participants with training plans, online coaching, or social support to help them prepare for events and maintain their physical activity levels (Wattanapisit et al., 2020; Wattanapisit et al., 2020). Others may offer incentives, such as medals, T-shirts, or other rewards, to motivate the participants (Helsen et al., 2022; Knittle et al., 2018). The effectiveness of virtual races also depends on factors such as race length and type of activity required. Additionally, the specific population targeted by the virtual race may affect its effectiveness, as some groups may be more receptive to virtual activities than others (Wattanapisit et al., 2020). One review on the virtualization of sports events during the COVID-19 pandemic (Westmattelmann et al., 2021), found that evidence regarding the benefits of sports events in this form is still lacking; therefore, the application needs to be evaluated to further assess the implementation of the proposed evaluation structure.

The present study has several limitations that should be considered when interpreting the results. First, the sample size was relatively small, and the study was conducted in a single geographical location, which may limit the generalizability of the findings to other populations and other settings or populations. Second, the study relied on self-reported physical activity data, which may have been subject to recall or social desirability biases. Participants may have overestimated their physical activity levels, particularly in response to the virtual race event, which may have inflated the reported results. Therefore, the level of physical activity should be measured directly and objectively using wearable devices or physical activity measurement tools. Third, while we clearly defined inclusion and exclusion criteria (e.g., absence of cardiovascular disease and mobility impairment), the study did not collect data on other potentially influential factors, such as seasonal changes, concurrent health interventions, socio-economic status, education level, psychological motivation, or previous experience with virtual platforms that could have influenced the reported physical activity levels. These variables may play a significant role in physical activity behavior and responsiveness to interventions. Participants with higher intrinsic motivation or digital literacy may have been more likely to engage and benefit from the virtual race, regardless of baseline physical activity level. Other variables concerning various age groups, height, weight, body mass index (BMI), and gender. The demographic and anthropometric characteristics of our participant pool may not fully reflect the broader population, which could impact on the generalizability of our findings. Given that physical activity levels are profoundly influenced by age, gender, and anthropometric measures such as weight, height, and BMI, the specific composition of our study group warrants careful consideration. For instance, physical activity patterns and intensity often vary significantly with age, with declines typically observed in older adults (Wattanapisit et al., 2020; WHO, 2022). Similarly, gender-specific differences in activity preferences and engagement are well-documented (Logan et al., 2024; Piercy et al., 2018).

Furthermore, an individual's weight, height, and BMI are intrinsically linked to their physical capabilities and typical activity profiles, with abnormal BMI often correlating with poorer physical fitness (Ding & Jiang, 2020) and physical activity being crucial for weight management (Cox, 2017). Fourth, data on the long-term effects of virtual race events on physical activity levels were not collected. It is possible that changes in physical activity levels observed immediately after the event were not sustained over time. Then, this study did not assess the potential negative effects of a virtual race event such as injury or overexertion. One important limitation of this study relates to the comparability between the AG and the SG. Participants in the AG had already achieved moderate to high levels of physical activity prior to the virtual event (≥600 MET-minutes/week), which may have resulted in a ceiling effect and limited the observable impact of the virtual race. In contrast, the SG had minimal physical activity at baseline, creating an imbalance in initial conditions between the groups. As such, the observed differences in post-event outcomes may reflect pre-existing behavioral patterns rather than the isolated impact of the virtual race itself. This design limits our ability to draw definitive conclusions regarding the effect of the intervention.

Ideally, future studies should use matched control groups with similar baseline activity levels or apply randomized controlled designs to ensure comparability and reduce bias. Stratified random sampling may also enhance the validity of group comparisons (Elfil & Negida, 2017). Future research should also consider a more comprehensive baseline assessment, including motivational, psychological, and socio-demographic factors, to better understand their influence and ensure more balanced group comparisons (Sella, et al., 2021). Furthermore, incorporating a third group that does not participate in any intervention could help clarify the specific influence of the virtual competition on behavioral change.

Despite these limitations, our study contributes preliminary evidence suggesting that virtual race events may have short-term influence on physical activity among sedentary individuals. However, to promote sustained physical activity behavior, virtual events may need to be integrated with additional behavioral strategies and long-term engagement tools. Future research should explore larger, more diverse samples and consider using mixed methods to better understand participant experiences, motivation, and barriers. Incorporating behavioral change models and digital health interventions may also enhance the effectiveness of virtual platforms in promoting long-term physical activity.

4. CONCLUSION

In conclusion, the study investigated the the potential impact of virtual race events on physical activity behavior among adults, particularly those with a sedentary lifestyle. Despite observing a decrease in active categories among participants in the AG and an increase in the SG post-event, statistical analysis revealed no significant difference between the groups. It is important to note that while the study did not find a significant difference, these findings have important implications for understanding the effectiveness of virtual race events in promoting sustained physical activity behavior. Future studies with larger, more diverse populations and objective measures of physical activity are recommended. Integrating behavioral support strategies, such as coaching, incentives, or social engagement features, may also enhance the long-term impact of virtual race events on physical activity behavior.

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