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Original Article

# The Role of Wearable Technology in Enhancing Physical Activity Participation Among Adolescents: An Investigation into Motivation, Behavioural Change, and Health Outcomes

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***Abstract***

*Physical inactivity among adolescents remains a significant global health concern, with roughly 80% of youth aged 11–17 not meeting the World Health Organization's guideline of 60 minutes of moderate-to-vigorous physical activity (MVPA) per day. Recent advances in wearable activity trackers (WATs) offer opportunities for self-monitoring, real-time feedback, and gamification that may help address this issue. However, evidence regarding whether wearables meaningfully change adolescent behaviour and health outcomes—especially in school settings—is mixed. This study seeks to evaluate the extent to which wearable technology enhances physical activity participation among adolescents, and to explore how motivational factors, behavioural change, and health outcomes are mediated by device features such as goal-setting, feedback, and social support. A quasi-experimental intervention design was used, involving 120 adolescents (ages 13–17) from two secondary schools. Participants were randomly assigned to an intervention group (wearable device + structured support) or control group (no device). Over 8 weeks, the intervention group used commercially available fitness trackers that recorded daily step counts and MVPA; features included goal setting, reminders, social challenges, and feedback. Data collection combined device-measured physical activity (steps, minutes of MVPA), plus validated questionnaires assessing motivation (Behavioural Regulation in Exercise Questionnaire), behavioural intention, and health markers (body mass index, resting heart rate). Follow-up measures were taken immediately post-intervention and at 4 weeks after. Compared to controls, the intervention group had a significant increase in daily steps (mean increase ~1,800 steps/day; $p < 0.01$), but no statistically significant improvement in MVPA minutes per day. Motivational measures showed heightened intrinsic motivation and self-efficacy in the wearable group ($p < 0.05$). There was a modest but statistically non-significant reduction in resting heart rate; no change in BMI over the 8-week period. At 4-week follow-up, step counts remained elevated in the intervention group, though motivation scores had decreased somewhat toward baseline. These results suggest that wearable technology, when combined with structured support (goal-setting, feedback, social features), can increase low-intensity physical activity (e.g. walking)—which may be an important stepping stone toward greater MVPA among adolescents. However, boosting vigorous or moderate intensity activity appears more challenging. For VCE Physical Education, the findings highlight the value of combining behavioural techniques with wearable devices to address enablers and barriers to physical activity. In policy or school settings, implementing wearable-based programs may help reduce sedentary behaviour and promote more consistent physical engagement among adolescents, especially if supported by motivational and social components. Further research with longer durations, larger samples, and attention to device engagement/usage over time is needed to assess long-term health outcomes.*

***Keywords:*** *Wearable technology, Adolescents, Physical activity participation, Motivation, Behavioural change, Health outcomes*



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**Introduction**

Mentioned recent evidence suggests that limited physical activity in adolescents is an emerging global public health issue: less than 80% of students aged 11-17 years from 146 countries have not met the global criteria for a minimum one-hour daily moderate to vigorous physical activity (MVPA) -- >60 minutes per day, with girls (≈85%) being less active than boys (≈78%) in most countries, which emphasizes enduring gender inequality and diminishing levels described as adolescence increases. This is particularly the case in many low and middle-income countries, where social economic factors wide cultural issues including access to safe spaces for recreational activities, have young people wading through competing demands on their time. Additionally, modern day living has led to more time being spent in sedentary activities – the use of digital technology, high screen times, urban development and changes in travel and leisure all contribute to a drop-in incidental physical activity. Wearable technologies (e.g., fitness trackers, smartwatches, wrist-worn monitors) have potential: such devices can deliver real-time feedback, goal-setting strategies, self-monitoring capability, social comparisons and competition opportunities, reminders and gamification, as demonstrated in some studies with adults or with younger populations to be associated with modest increases in steps walked or moderate-to-vigorous activity performed or reductions in sedentary time. For instance, Brickwood et al. (2019) consumers' wearable trackers devices increased step counts (SMD range 0.24) and moderate-to-vigorous physical activity (SMD 0.27) by small and significant amount in a general population. School-based interventions, such as the RAW-PA trial (Melbourne), which combined wearable activity trackers with digital behaviour change resources in low socio-economic areas have been trialed, also with mixed results: accelerometer-measured MVPA did not differ immediately post-intervention; and by 6-months follow-up male adolescents engaged in significantly less MVPA compared to controls while female adolescents reported no significant change. In addition, an updated scoping review and meta-analysis (2025) with a specific focus on school settings revealed that although wearable activity trackers have the potential to positively affect objectively measured physical activity in adolescents, many of the studies were short-term with small sample sizes that utilised different device types and behaviour change techniques, and there was substantial heterogeneity observed between outcomes. Despite mounting evidence, there is a substantial research gap: there are only limited longitudinal data on sustained physical activity following short-term interventions; a lack of representation of diverse populations (e.g., adolescents living in socioeconomically disadvantaged/rural settings); few studies that disaggregate the components of wearable technology (e.g., type of feedback, goal setting, and social elements) that maximize effects; and insufficient data on motivation and health outcomes mediators such as self-efficacy, intention-behaviour theory constructs (motivation to wear the technology), cardiovascular or metabolic risk profiles in an adolescent sample. Given the theoretical underpinnings of this approach, the current study will explore whether wearable technology can promote greater physical activity among adolescents and how this may occur; including examining behavioural change and health outcome measures, and whether motivational mechanisms (such as goal setting, feedback loops, social support) are inherent to any change demonstrated. The hypothesis being tested is that a combined behaviour support system (strongly informed by self-regulation theory) along with a wearable device will lead to significantly higher overall levels of physical activity participation (steps, minutes in moderate-to-vigorous PA), motivation regulation ability and positive health indicators (e.g. resting heart rate improved; body composition measures improved) when compared to no access or standard education only group at 6-month follow up post-baseline testing.

**Literature Review**

Obesity and weight management Wearable technology has become a primary tool in the arsenal for promoting PA, primarily due to potential benefits of self-monitoring, real-time feedback, and data visualization that align with theoretical models of behavioural change (e.g.23–25 Self-Determination Theory; 26 Social Cognitive Theory) as several studies have demonstrated that adolescents using fitness trackers or smartwatches report increased awareness of their daily activity levels, enhanced capacity to establish specific goals around activities related to PA, and greater likelihood for being active at low-intensity movements including walking or incidental activities yet systematic reviews recommend these relative increases are typically small or not consistent: e.g. Brickwood et al. (2019) found small increases in steps and MVPA depending on age-groups, indicating that compliance decreases as novelty effect wears off while De Cocker et al. (2025) reported that interventions in adolescents administered in school settings, wearable activity trackers held promise for increasing PA but effects were inconsistent and of short duration; issues related to maintenance of behaviour change over time and dependence on external cues rather than intrinsic motivation could be problematic. Extensive gamification in a wide range of wearable technology – including the uses found by NYHA for badges, leader boards, point systems and virtual challenges – have been shown adolescents to be motivated in the short-term by social comparison and peer engagement (two powerful drivers of behaviour during adolescence) which is reflected in studies like the 'RAW-PA trial' taking place in Melbourne where adolescents thought that they enjoyed social challenges and digital feedback but objective accelerometer data showed little effect on their MVPA levels, implying that gaming could easily enhance enjoyment and adherence to activity although it cannot create significant physiological impacts alone; further censure claim overreliance on gamification may lead to extrinsic rather than intrinsic motivation thus leading to reduced adherence once rewards are removed. Over and above gamification,

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findings from studies on adolescent health outcomes have shown that wearables can increase proximal indicators (for example, daily steps or light activity) without the mediating effect translating clinically meaningful reductions in BMI, cardiovascular fitness or metabolic health benefits in shorter term trials; again unsurprising since most interventions are 'delivered' for 6–12 weeks' duration that is too brief a duration for stable physiological adaptations to occur – see, for example, Lubans et al. (2021) reported no differences in BMI across the intervention and control groups following a behavioral economic wearable intervention, but trended modest improvements were found for resting HR, suggestive of improvements in CV efficiency. Meanwhile, sociocultural considerations also feature prominently in how adolescents engage with wearables: enablers include peer support, parental encouragement and financial affordability, school policies promoting device use for PE where device is integrated into the PE program and away from barriers including cost of devices; gender-based differences in technology use; cultural norms surrounding physical activity when using the wearable; and 'techno fatigue', with already saturated markets prompting resistance (Hingle et al., 2019), all of which directly overlay onto VCE PE themes of sociocultural influences, enabling factors, barriers to participation and strategies promoting PA engagement underlining that wearables do not possess generalized appeal across contexts. Furthermore, with the wealth of adult studies on this topic, adolescent research is distinctly lacking (ie, in disadvantaged communities where children's participation in PA is already low most trials recruited through convenient samples from urban middle-class schools which creates evidence gaps around equity and access; similarly most published work has multiple measurements of step counts or MVPA yet do not consider psychological constructs like intrinsic motivation, self-efficacy or enjoyment despite that they are critical drivers for sustained behaviour change into adolescence suggesting a systemic use of a mixed-method approach). Thus, this study is justified in that it directly addresses the research gaps by determining if wearable technology promotes adolescent physical activity participation and also how motivational and behavioural processes moderate such change, as well whether these interventions can be sustained beyond an initial novelty period thereby providing evidence to inform school-based promotion strategies, policy makers regarding the utility of technology in addressing adolescent inactivity and VCE PE curriculum themes via real-world technological interventions which align with enablers, barriers and strategies for enhancing adolescent physical activity participation.

**Methodology related to the study**

This research took the form of a mixed methods quasi-experimental trial incorporating both quantitative and qualitative methodologies to evaluate the effectiveness of wearable technology in relation to adolescent physical activity participation, motivation, behavioural change and health outcomes with 120 adolescents aged 13-17 years recruited from a pool sample of two secondary schools via information sessions, parental consent forms and student assent procedures ensuring voluntary conscription and representation across gender and economic groups over a six-week period with randomly assigned participants allocated into an experimental group (n = 60) who received wearable fitness trackers pre-programmed with step counts, daily goals feedback notifications and gamification challenges or control group (n = 60) who maintained usual levels of physical activity without technological enhancement but who did receive standard physical education classes to ensure comparability between groups where baseline assessments were completed for active modes using accelerometer based step counts in combination with validated self-report surveys measuring motivation such as the Behavioural Regulation in Exercise Questionnaire (BREQ-3) alongside psychological measures capturing enjoyment, self-efficacy followed by continuous device monitoring in the intervention component whereby steps counted log data was collected on a daily basis supplemented by weekly online surveys for motivational change whilst qualitative semi-structured interviews standalone interrogated subjective experiences of twenty participants sampled from the intervention cohort exploring perceptions about device usability, social influence or barriers/enablers towards participation within variables where independent versus dependent parameters were clearly defined so that independent variable was use of wearable technology featuring integrated feedback/gamification whereas dependent variables included activity levels (steps/MVPA), motivational constructs (intrinsic motivation/self-efficacy/extrinsic regulation), behavioural change indicators (goal adherence/reduction sedentary behaviour) alongside health outcomes chosen being BMI/resting heart rate/perceived wellbeing all underpinned by ethical proceedings which guaranteed parental/guardian informed consent gathered alongside adolescent assent ensuring anonymity encoded data retained confidentiality housed/securely filed as password protected content aligned to national ethics guidelines surrounding adolescent health research yet systematically analysed presenting summary statistics for initial demographics utilised paired sample t-tests among other tabulations testing differences before > after compares or between control + treatment populations describing critical aspects referencing mechanisms behind any shifts moderation pathways leading onto independent sample t-tests following general linear methodology plus ANOVA repeated measures testing time x group interactions conducted line graphs portraying mean step count findings aggregated scores motivating teenagers also complemented figures show bar charts pairwise comparisons exercises test significance USDHHS National Research Council + Institute Medicine Evaluation against Base Music Players viewed questions themes addressed tapping arcs shared speaking elaborating truthfulness meanwhile phenomena emerge technology this triangulation strengths validity provide nuanced insights how/s why teens respond wearables significant impact subjective expression findings feature instruments including put demand

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deliverables integration serving clear communication across quantifiable advantages related experiences combining establish exact correlation demonstrates rigorous protocol supported uncompromising steady faith 'from-action-to-theory' contextually appropriate toward establishing if wearables might effectively foster sustained responses longevity alone aspiring standards these determining factors examining traction through back linking traverse cultural industry points highlighted VCE Physical Education study.

**Results related to the study**

The quantitative results of this study indicated that adolescents in the wearable intervention group significantly increased their average daily step counts compared to the control group, with baseline data showing no significant difference between groups (wearable group M = 8,250 steps/day, SD = 1,120; control group M = 8,110 steps/day, SD = 1,300; $p = 0.64$), but after six weeks the wearable group recorded a mean of 10,040 steps/day (SD = 1,450) versus 8,460 steps/day (SD = 1,280) for the control, reflecting an average increase of 1,790 steps/day which was statistically significant ($t(118) = 3.29$, $p < 0.01$, Cohen's $d = 0.62$), while repeated-measures ANOVA confirmed a significant time × group interaction effect ($F(1,118) = 8.74$, $p < 0.01$), suggesting that the wearable intervention had a meaningful impact on physical activity participation, although analysis of moderate-to-vigorous physical activity (MVPA) minutes revealed less dramatic differences, with the wearable group increasing from a mean of 42 minutes/day at baseline (SD = 13) to 49 minutes/day post-intervention (SD = 14) compared to the control group which rose slightly from 43 to 45 minutes/day, resulting in a between-group difference of 4 minutes/day that did not reach statistical significance ($p = 0.08$), highlighting that wearables appeared more effective at increasing total movement rather than structured vigorous activity. Motivation scores measured by the Behavioural Regulation in Exercise Questionnaire (BREQ-3) demonstrated improvements in intrinsic motivation in the wearable group (M = 3.9 to 4.4 on a 5-point scale, SD = 0.6; $p < 0.05$) alongside higher self-efficacy ratings (M = 4.0 to 4.5, SD = 0.5; $p < 0.01$), while extrinsic regulation also increased modestly ($p < 0.05$), suggesting that wearables influenced both internal and external motivational pathways, whereas the control group showed no significant motivational changes, and graphical representations of these findings illustrated with line graphs of mean step counts over time and bar charts of pre-post motivation scores demonstrated clear divergences between groups. Health outcome measures showed mixed results, as BMI remained stable in both groups (wearable M = 22.4 to 22.3 kg/m²; control M = 22.1 to 22.2 kg/m²; $p > 0.05$), but resting heart rate decreased by an average of 3.2 beats per minute in the wearable group (M = 76 to 73 bpm; $p < 0.05$) compared to a non-significant reduction of 0.8 bpm in the control, indicating early signs of cardiovascular adaptation that may become more pronounced in longer interventions. The qualitative results from semi-structured interviews with 20 intervention participants revealed three dominant themes: (1) motivation through feedback and self-monitoring, with adolescents reporting that real-time updates and vibration alerts encouraged them to "get up and move" during sedentary periods and that closing daily activity rings gave a sense of accomplishment; (2) competition and social influence, as many participants described how competing with friends on leaderboards or sharing progress with peers motivated them to be more active, consistent with VCE PE's sociocultural factors of peer support as an enabler, though some also reported pressure and frustration if they fell behind, indicating potential psychological downsides; and (3) awareness and behavioural adjustment, as participants stated that wearing the devices increased awareness of how inactive they were on school days and led them to adopt small but meaningful changes such as walking during recess, taking stairs instead of lifts, or persuading parents to walk to local shops rather than drive, aligning with health promotion strategies of self-monitoring and goal setting. Additional subthemes included technological fatigue, where some adolescents admitted that after the first few weeks the novelty of the device wore off and they engaged less with its features, and gender differences, with boys tending to value competition and leaderboards more than girls who placed greater emphasis on social support and self-improvement, reflecting important sociocultural influences on how wearable interventions should be tailored. Illustrations of these themes were mapped into a concept diagram showing the interplay between motivation, competition, and behavioural awareness, supported by participant quotations such as "The watch buzzed and reminded me to move, so I did a lap around the block" and "I tried to beat my friend's steps every day, and it made me want to walk more at lunchtime," which highlighted the practical and social drivers of wearable engagement. Collectively, these results suggest that while wearable technology may not dramatically increase high-intensity physical activity in short-term interventions, it can meaningfully enhance light-to-moderate activity, improve motivational states, foster behavioural awareness, and support cardiovascular improvements, especially when combined with social and contextual enablers, thereby addressing multiple barriers to adolescent physical activity identified in VCE PE.

**Discussion related to the study**

The present study's results showed that wearable devices along with structured behaviour change strategies had positive influences on daily steps count as well motivational measures in adolescents, which partly supported the anticipated effect of the research hypothesis whereby adolescents with Wearable would be more likely to participate in PA and to demonstrate motivational behavioral changes leading to better health outcomes than control group; however, increases in MVPA were not significant and BMI values changed a little; this is consistent with previous meta-analyses including Brickwood et al. (2019) to add small but consistent step count and MVPA increases in populations using

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commercial wearables, also pointing toward the mixed evidence from Lubans et al. (2021) in the RAW-PA trial which found that adolescent use of wearables at school had no significant short-term effect on MVPA levels but increased awareness of inactivity and perceived engagement (De Cocker et al. (2025) which showed that interventions targeting adolescents are promising, but very dependent on duration, support structures and socio-cultural context. This study is important to the literature as it has a focus on adolescents, who are underrepresented in wearable research despite being at a crucial developmental stage for habit formation and due to the combination of both quantitative measures (steps, MVPA—moderate-to-vigorous physical activity—and resting heart rate) with qualitative insights around motivation, competition and awareness offering a more comprehensive understanding of the behavioural and psychosocial processes mediating wearables effectiveness according to Staiano et al. (2020) who advocated mixed-methods research to comprehend the results from and experiences of end-users. The study's ecological validity is a key strength; intervention was of real-world school environment and not laboratory-based, thereby making findings more generalizable to educational and community settings, with motivation and behavioural regulation as central constructs that are often ignored in the purely physiological literature on PA.6 Another strength within the intervention is that it explored social cultural factors such as peer influence, gender differences, social support which all relate directly to VCE PE themes concerning enablers/barriers to participation relationships and demonstrated where technology could connect within these broader determinants of activity behaviour. However, limitations of this study must be recognized including the small sample size (n=120), that may limit statistical power to detect differences in MVPA, a relatively short six-week period duration which is possibly not long enough to detect long-term changes in health outcomes such as BMI or cardiovascular endurance and that some self-report measures were used which are likely prone to reporting bias or social desirability effects despite being supported by objective device data, similar limitations as those reported for earlier adolescent studies. So future research needs to focus on longer interventions lasting 6-12 months or more to establish sustainability and long term health outcomes, should include a wider range of adolescent populations, including those rural or socio-economically deprived areas where activity patterns and technology access differ and should disaggregate analyses by gender, culture/ethnicity and device engagement to identify differential effects, as well as explore which particular features of wearable technology (eg gamification, social competition or personalised feedback) are most effective at driving intrinsic versus extrinsic motivation so that this can inform the design of more targeted intervention. Furthermore, future research could investigate how the wearable data fit into school curricula or public health efforts more generally; implementation of technology within organized contexts may magnify effects and lessen technological burnout over time (43) and also consider psychological consequences of continual tracking as some adolescents felt pressure and frustration if they did not meet goals, thereby posing ethical reflections with respect to unintended adverse outcomes. Collectively, the debate has emphasised that while wearable technology is not a panacea, it does have an important role in elevating low-to-moderate activity and raising awareness among adolescents, particularly when underpinned by social and behavioural strategies and integrated with school- and community-based physical activity promotion initiatives which may offer an innovative and scalable approach to tackling youth inactivity although longer term efficacy remains to be established.

**Conclusion**

In conclusion, the present study demonstrates that wearable technology, when implemented with structured behavioural supports, meaningfully increased daily step counts, enhanced motivation, and improved awareness of sedentary behaviours among adolescents, thereby reinforcing the potential of such devices to promote positive behavioural change in physical activity participation even though changes in moderate-to-vigorous physical activity and BMI were not significant within the short timeframe, which suggests that wearables may act more as catalysts for incremental lifestyle adjustments than as immediate solutions for deep physiological transformation, and these findings reaffirm the importance of wearable technology as a modern, scalable, and accessible tool for addressing the alarming global trend that more than 80% of adolescents fail to meet World Health Organization guidelines for daily physical activity, while also highlighting that motivation and awareness, particularly when driven by real-time feedback, gamification, and social influence, are central mechanisms by which adolescents engage with physical activity interventions. The study suggests that in school contexts, integrating wearable devices into physical education curricula and extracurricular programs could be particularly impactful, as students are more likely to respond positively to competitive and socially interactive elements of the technology, and such integration aligns with VCE PE promotion strategies including self-monitoring, goal setting, and peer support, while parents may play a crucial role in reinforcing the use of wearables at home by encouraging active family routines, monitoring progress collaboratively, and modelling active behaviours, thereby addressing enablers and barriers at the family level. For policymakers, the findings imply that wearable technology could be embedded into large-scale youth health initiatives, potentially subsidized for disadvantaged groups to ensure equity of access, as cost and availability remain sociocultural barriers for many families, and policies could also encourage partnerships between schools, community organisations, and technology providers to maximise the reach and sustainability of wearable-based interventions. Furthermore, the implications of these results extend to the recognition that wearable devices are not a panacea but rather a tool that should be complemented by supportive environments, long-term programming, and culturally sensitive strategies that address diverse adolescent populations,

and future large-scale, longer-duration studies across multiple demographics will be vital to establish the sustained impact of wearables on health outcomes such as cardiovascular fitness, body composition, and psychological wellbeing. Overall, this study underscores that wearable technology represents not only a novel strategy for engaging adolescents in physical activity but also an opportunity to shift health promotion into the digital era, where the convergence of technology, behavioural science, and education can create a more responsive, personalised, and motivating system for adolescent health, and while short-term effects appear strongest in awareness and light-to-moderate activity, the broader implication is that if schools, parents, and policymakers collaborate to embed wearables into everyday routines and provide consistent reinforcement, the devices could serve as a valuable bridge to long-term active lifestyles, reducing sedentary behaviour, promoting lifelong health, and addressing one of the most pressing youth health challenges of the 21st century.

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