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Effective management of sedentary behavior among Indian university students: An empirical exploration into health-related behavior

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Abstract:

BACKGROUND: The past few years have witnessed a notable rise in sedentary tendencies, unveiling a modern era of prolonged stillness and diminished physical engagement. This study sought to assess the feasibility of a digital health intervention (DHI) to reduce overall sedentary behavior among university students. The study also identifies distinct subgroups within Indian universities that exhibit a heightened propensity for engaging in unhealthy behaviors.

MATERIALS AND METHODS: The research design used was a quasi-experimental (pre–post) design. A total of 500 participants were selected using a simple randomized sampling method (250 belonging to the control group and 250 belonging to the experimental group). These participants actively engaged in the study for 2 weeks. The participants completed the Sedentary Behavior Questionnaire (SBQ) before the intervention to evaluate their level of sedentary behavior. To evaluate the impact of the intervention on subjectively measured sedentary behavior, statistical analyses were conducted using the paired-samples *t*-test and analysis of covariance (ANCOVA) with the *post hoc* Bonferroni test.

RESULTS: The findings demonstrated a significant t-value of sedentary behavior for the entire group, with $t(249) = 4.88$, $P < .05$. Furthermore, the F-value of 28.787 indicated a statistically significant difference in the sedentary behavior between the experimental and control groups. When considering female university students specifically, the t-value for sedentary behavior was significant at $t(105) = 3.22$, $P < .05$, and for male university students, the t-value for sedentary behavior was found to be significant at $t(143) = 3.69$, $P < .05$.

CONCLUSION: Smartphone-based health interventions targeting sedentary behavior reduction demonstrated promising outcomes in facilitating health behavior change among university students.

Keywords:

Health promotion, intervention study, sedentary behavior, students

Introduction

Sedentary behavior includes activities characterized by low energy expenditure (i.e., >1.5 Metabolic Equivalents (METs)), primarily involving a seated, reclined, or lying posture maintained during waking hours.[1] The minimal energy expenditure associated with sedentary behavior emerges as a catalyst for the degenerative effects inflicted on the human body. The underutilization of bodily systems during periods of inactivity is believed to contribute to metabolic, hormonal, and muscular imbalances, potentially compromising the anti-inflammatory effects exerted by skeletal muscles and further fostering systemic dysfunction.[2] Increased levels of sedentary behavior can lead to musculoskeletal issues and noncommunicable diseases (NCDs), such as cardiovascular diseases,

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osteoporosis, diabetes, and the insidious specter of cancer.[3] Emerging evidence suggests that sedentary behavior is a distinct and independent risk factor for the health impairments mentioned.

The worldwide impact of increased sedentary time is evident, contributing to approximately 3.8% of all-cause mortality.[4] The prevailing consensus in contemporary research substantiates the heightened perils associated with augmented sedentary behavior, as it emerges as a significant risk factor for premature mortality and NCDs.[4-7] Nevertheless, there is disagreement concerning the elusive threshold of daily sitting time. The point at which the accumulation of sitting hours presents a substantive health risk is still being determined. A recent review discovered negative impacts at a daily sitting period of more than 3 hours per day.[4] Additionally, each additional hour of sitting beyond a daily threshold of 7 hours corresponds to a 5% augmented risk of all-cause mortality.

The influence of sedentary behavior is particularly heightened within the young demographic, specifically those aged between 18 and 29 years.[8] Engaging in long periods of sedentary behavior is linked to negative consequences for both physical and mental well-being.[9,10] Current public health guidelines advocate for individuals to actively reduce their sedentary time and intersperse prolonged periods of sedentary behavior with regular breaks.[11] The overall body of research on sedentary behavior has predominantly centered around individuals engaged in desk-based office work,[12,13] considering a significant portion of their waking hours are spent sitting. Like office workers, university students also allocate a significant portion of their waking hours to desk-based activities, encompassing studying, attending lectures, and engaging in academic pursuits.[14] Intervention studies tailored to tackle the sedentary tendencies of university students are on the rise,[8] as individuals in the age range of 18–29 exhibit a notable rise in sedentary behavior, characterized by increased time spent sitting. This population's mean daily sitting duration is 605 minutes per day (equivalent to 10 hours), with approximately 2 hours per day specifically attributed to sedentary behavior involving electronic media.[15,16] Therefore, the principal aim of this study was to examine the effectiveness of a digital health intervention (DHI) in reducing sedentary behavior among university students.

Recent years have witnessed increased intervention studies, specifically designed to address sedentary behavior among university students.[15,17] A randomized control trial unveiled promising results, showcasing the potential of a text message-based intervention to foster non-sedentary behaviors, with a particular emphasis on promoting light-intensity physical activity among university students.[18] Peng *et al*.[19] (2022) conducted a comprehensive systematic review, shedding light on the transformative power of electronic health (e-health) interventions in promoting physical activity. The review unearthed the significant impact of interventions on various aspects of physical activity, including total physical activity, moderate-to-vigorous physical activity, and step count, following the intervention period. Additional interventions have employed a novel approach by implementing environmental modifications to assist students.[17,20]

Studies have emphasized the importance of considering psychological aspects when designing interventions or programs to promote physical activity for young adults, as these factors play a significant role.[21] Behavior change techniques (BCTs) have consistently been recognized as fundamental strategies for enhancing physical activity and reducing sedentary behavior. These approaches encompass goal setting, action planning, feedback provision, reward systems, and social support networks.[22,23] A comprehensive review synthesizing the effect sizes of interventions targeting sedentary behavior outcomes identified a noteworthy decrease in sedentary time within the group receiving BCT interventions.[24]

Prior research has predominantly concentrated on conventional intervention methods, primarily employing text-based or in-person methodologies.[25,26] Moreover, the majority of these studies mainly target office workers and older adults.[27-29] However, it is worth noting that the issue of sedentary behavior is widespread among university students, a demographic grappling with distinct challenges stemming from their lifestyle and academic commitments. What sets the present research apart is the recognition of the unique characteristics of this age group. University students are not only highly proficient in Internet use but also well-acquainted with digital technologies.

Their seamless navigation of the digital landscape and mastery of Internet usage make them prime candidates for innovative strategies aimed at promoting physical activity and mitigating sedentary behavior. Their adept use of the Internet presents a valuable opportunity for the extensive integration of e-health interventions within the campus. Hence, establishing the efficacy of e-health interventions in diminishing sedentary behavior among college students will furnish compelling empirical support for the formulation of tailored interventions in this context.

Materials and Method

Study design and setting

Data for the quasi-experimental study employing a pretest or posttest design were collected online and offline

modes. Participants' baseline assessment of sedentary duration was conducted one day before the initiation of the intervention. Sedentary time was assessed using the Sedentary Behavior Questionnaire (SBQ). Following the baseline assessment, participants received detailed instructions to download the health intervention-based mobile application, which was available for Android and iOS users. The intervention was implemented for 2 weeks. Following the conclusion of the intervention, participants' sedentary behavior was reassessed using the SBQ.

Study participant and sampling

The target sample size for this study was set at 500 participants, requiring the researcher to approach a total of 1000 students. Of these, 697 students provided their informed consent to participate. However, 197 participants could not complete the study within the specified 2-week time frame due to personal commitments. Despite this, the researcher successfully achieved the intended sample size of 500 participants, of which 250 participants were assigned to the control group and 250 were assigned to the experimental group. The majority of participants (85.3%) fell within the age range of 18–22 years, while 14.7% were between the ages of 23 and 27. Participants consisted of 45.2% males and 54.8% females.

Inclusion and exclusion criteria

Participants within the age range of 18 to 27 were eligible for inclusion in the study. Individuals with any medical condition that limited their ability to engage in physical activity were excluded from the study. Only students from the targeted population were recruited as participants.

Data collection tools and technique

Sedentary behavior was evaluated through the utilization of the SBQ. A readily available health intervention-based application was utilized in this study. The application was designed to deliver personalized prompts to users, urging them to take regular breaks and engage in periodic physical activity throughout the day. The application provided a diverse selection of guided exercise breaks tailored explicitly for university students who engage in prolonged sitting [Table 1]. The development of the application was informed by established BCTs supported by previous research.[30,31] The application incorporates elements of social cognitive theory and the transtheoretical model to deliver personalized reminders, facilitate goal setting, and provide user feedback.[30] The application also incorporates a self-monitoring feature, enabling users to receive feedback on their behaviors.[31] Various movement breaks that focus on body mobilization, stretching, strength training, mood enhancement, and muscle relaxation were included in the application. Users were able to track and monitor their break time duration.

Table 1: Exercises to break the sedentary routine

Exercise procedure
Walking: Get up for a walk every so often throughout the day
Chest Expansion Stretch: Start in a seated or standing position. Inhale, stretch your arms wide pushing out your chest and looking up toward the ceiling
Wall Squat with Arm Raise: Stand tall with your back against the wall. Bend your knees slightly about 30 degrees. Rest the back of your head against the wall and keep your eyes forward and level to the ground. Raise your arms so your elbows are at a 90-degree bend, parallel to the ground. Make sure your hips and entire spine are pressed into the wall. Breathe in and slide your hand and elbows up the wall until you feel some tension. Breathe out and lower your arms back to 90 degrees keeping them touching the wall throughout this exercise. Repeat
Shoulder Blade Squeeze: Assume a seated or standing position with arms hanging down and shoulders relaxed. Slowly contract the shoulder blades toward each other and expand the chest. Move the arms to the back and clasp the elbows. Repeat
Wall Stretch: Assume a seated or standing posture, with your arms resting by your sides and shoulders relaxed. Gradually tighten your shoulder blades and expand your chest. Move your arms behind your back and interlock your elbows. Maintain the pose for a while
Shoulder Rotation: Assume an upright seated or standing posture, keeping your feet positioned shoulder-width apart and your arms relaxed and hanging down by your sides. Draw as big of a circle as you can with both your shoulders at the same time. As your shoulders are moving back, inhale and stick your chest out. As your shoulders are moving forward, exhale and sink your chest inward. Repeat for a complete set and then reverse direction
Interlaced Finger Chest Stretch: Put arms behind your head, with fingers interlaced and elbows pointing outward. Pull your elbows back, ring your shoulder blades together and look up at the ceiling
Seated Chair Stretch: Sit tall by the edge of your chair. Put your hands behind the lower part of your neck and keep your chin tucked. Open up your check by bringing your elbows outward and squeezing your shoulder blades together. Round your back forward as you bring your elbows back together. Repeat
Standing Side Stretch: Stand with your feet hip-wide apart. Reach one arm toward the ceiling as far as possible while letting the other arm sink down toward the ground. Maintain an upright posture without leaning forward or backward, and sustain the position. Repeat the same action on the opposite side
Doorway Back Stretch: Stand inside a doorway and put the back of your hands up on the door jam. Lean your body back until your arms are out in front of your body. Go as far as you feel comfortable. Push into your hands and bring yourself back up. Repeat

Ethical consideration

This study was conducted with approval from the Ethics Committee of Pandit Deendayal Energy University and with the required coordination with relevant educational authorities (Research Ethics Code: ODRD/EC/2023/17/04).

Results

Analysis

The study hypothesis was analyzed using.

(1) Descriptive statistics—mean and standard deviation (SD), (2) paired-samples *t*-test (to assess the significant difference between the pretest and posttest means), and (3) one-way analysis of covariance (ANCOVA) (to examine differences between groups).

a) Relation between DHI and sedentary behavior (*t*-test comparison).

The mean and SD scores [Table 2] for the pretest and posttest of the control group were M_pre = 6.51, SD_pre = 1.99, M_post = 6.69, and SD_post = 1.85. The mean and SD scores for the pretest and posttest of the experimental group were M_pre = 6.84, SD_pre = 2.11, M_post = 6.26, and SD_post = 2.16. The t-value was found to be significant at t(248) = 4.88, $P < .05$. The experimental group exhibited a significant decrease in sedentary behavior from the pretest (M = 6.84) to the posttest (M = 6.28) following participation in DHI. The descriptive statistics and paired-samples t-test comparing sedentary behavior between the control and experimental groups, as discussed above, correspond to Table 2.

Table 2: Effect of DHI on sedentary behavior

Variable	Groups	Sub groups	*n*	Mean	SD	*t*	*P*
Sedentary Behavior	Control group	Pretest	250	6.51	1.99	4.88	<0.001**
		Posttest	250	6.69	1.85		
	Experimental group	Pretest	250	6.84	2.11		
		Posttest	250	6.29	2.18		

**Significant at the 0.01 level; *significant at the 0.05 level

Therefore, there is a significant relationship between digital health intervention (DHI) and sedentary behavior of college students.

b) One-way ANCOVA: Sedentary Behavior.

The F-value of 28.787 indicated a statistically significant difference in the sedentary behavior of the experimental group (M = 6.26, SD = 2.16) compared with the control group (M = 6.69, SD = 1.84), with 1/497 df. The between-subjects effect analysis results show that pretest (F = 580.575, $P < .001$, $\eta p^2 = 0.539$) and group (F = 28.787, $P < .001$, $\eta p^2 = 0.055$) were both significant predictors of posttest sedentary behavior. The overall model was significant (F = 296.167, $P < .001$, $\eta p^2 = .544$), accounting for 54.4% of the variance in posttest sedentary behavior, adjusted $R^2 = .542$. The intercept was also a significant predictor (F = 63.447, $P < .001$, $\eta p^2 = .113$). The error term was estimated to be 1.875, with a total of 500 observations.

c) Relationship between DHI and sedentary behavior of male and female university students (*t*-test comparison).

The mean and SD scores [Table 3] for the pretest and posttest of the control group (males) were M_pre = 6.35, SD_pre = 2.03, M_post = 6.55, and SD_post = 1.77. The mean and SD scores for the pretest and posttest of the experimental group (males) were M_pre = 6.74, SD_pre = 2.03, M_post = 6.22, and SD_post = 2.20. The t-value was significant at t(143) = 3.69, $P < .001$. The

Table 3: Effects of DHI on sedentary behavior:Males and females

Variable	Groups	Subgroups	*n*	Mean	SD	*t*	Sig.
Sedentary behavior in males	Control group	Pretest	131	6.35	2.03	3.69	<0.001**
		Posttest	131	6.55	1.77		
	Experimental group	Pretest	144	6.74	2.03		
		Posttest	144	6.22	2.2		
Sedentary behavior in females	Control group	Pretest	119	6.68	1.93	3.22	<0.001**
		Posttest	119	6.83	1.92		
	Experimental group	Pretest	106	6.98	2.21		
		Posttest	106	6.35	2.15		

**Significant at the 0.01 level; *significant at the 0.05 level

Table 4: Effect of DHI on sedentary behavior:Age range of 18–22 and 23–27

Variable	Groups	Subgroups	*n*	Mean	SD	*t*	Sig.
Sedentary behavior in age range of 18–22	Control group	Pretest	216	6.25	2.01	5.26	<0.001**
		Posttest	216	6.7	1.87		
	Experimental group	Pretest	219	6.91	2.09		
		Posttest	219	6.27	2.19		
Sedentary behavior in age range of 23–27	Control group	Pretest	34	6.91	2.09	0.00	>0.05
		Posttest	34	6.27	2.19		
	Experimental group	Pretest	31	6.35	2.16		
		Posttest	31	6.35	2.09		

**Significant at the 0.01 level; *significant at the 0.05 level

experimental group exhibited a significant decrease in sedentary behavior from the pretest (M = 6.74) to the posttest (M = 6.22) among males following participation in the DHI. The analysis of the relationship between DHI and sedentary behavior among male and female college students, detailed earlier, corresponds to Table 3.

Therefore, there is a significant relationship between DHI and sedentary behavior of male college students.

The mean and SD scores for the pretest and posttest of the control group (females) were M_pre = 6.68, SD_pre = 1.93, M_post = 6.83, and SD_post = 1.92. The mean and SD scores for the experimental group (females) pretest and posttest were M_pre = 6.98, SD_pre = 2.21, M_post = 6.35, and SD_post = 2.15. The t-value was significant at t(105) = 3.22, $P < .001$. The experimental group exhibited a significant decrease in sedentary behavior from the pretest (M = 6.78) to the posttest (M = 6.35) among females following participation in the DHI.

Therefore, there is a significant relationship between DHI and sedentary behavior of female college students.

d) One-way ANCOVA: Sedentary Behavior (Male and Female).

The F-value of 14.556 for males indicated a statistically significant difference in the sedentary behavior of males in the experimental group (M = 6.22, SD = 2.20) compared with the control group (M = 6.55, SD = 1.77), with 1/272 df. The between-subjects effect vanalysis results show that pretest (F = 354.663, $P < .001$, $\eta p^2 = 0.566$) and group (F = 14.556, $P < .001$, $\eta p^2 = 0.051$) were both significant predictors of posttest sedentary behavior in males. The overall model was significant (F = 179.427, $P < .001$, $\eta p^2 = .569$), accounting for 56.9% of the variance in posttest sedentary behavior in males, where adjusted $R^2 = .566$. The intercept was also a significant predictor (F = 31.348, $P < .001$, $\eta p^2 = .103$). The error term was estimated to be 1.7615, with a total of 275 observations.

The F-value of 14.210 for females indicated a statistically significant difference in the sedentary behavior of females in the experimental vs. control groups, with 1/222 df. The between-subjects effect analysis results show that pretest (F = 226.720, $P < .001$, $\eta p^2 = 0.505$) and group (F = 14.210, $P < .001$, $\eta p^2 = 0.060$) were both significant predictors of posttest sedentary behavior. The overall model was significant (F = 116.965, $P < .001$, $\eta p^2 = .513$), accounting for 51.3% of the variance in posttest sedentary behavior in females, adjusted $R^2 = .509$. The intercept was also a significant predictor (F = 31.305, $P < .001$, $\eta p^2 = .124$). The error term was estimated to be 2.032, with a total of 225 observations.

e) Relation between DHI and sedentary behavior of university students aged 18–22 and 23–27 (*t*-test comparison).

The mean and SD scores [Table 4] for the pretest and posttest of the control group (age range: 18–22) were M_pre = 6.25, SD_pre = 2.01, M_post = 6.70, and SD_post = 1.87. The mean and SD scores for the pretest and posttest of the experimental group (age range: 18–22) were M_pre = 6.91, SD_pre = 2.09, M_post = 6.27, and SD_post = 2.19. The t-value was significant at t(218) = 5.26, $P < .001$. The mean score for pretest sedentary behavior in the experimental group (age range 18–22) was M = 6.91, which decreased to M = 6.27 in the posttest. This indicates a significant decrease in sedentary behavior among university students in the experimental group who participated in DHI.

Therefore, there is a significant relationship between DHI and sedentary behavior of college students within the age range of 18–22.

The mean and SD scores [Table 4] for the pretest and posttest of the control group (age range: 23–27) were M_pre = 6.91, SD_pre = 2.09, M_post = 6.27, and SD_post = 2.19. The mean and SD scores for the pretest and posttest of the experimental group (age range: 23–27) were M_pre = 6.35, SD_pre = 2.16, M_post = 6.35, and SD_post = 2.09. The t-value was not significant at t(30) = 0.00, $P > .05$. The sedentary behavior of university students aged 23–27 who participated in DHI did not show any significant change between the pretest (M = 6.35) and the posttest (M = 6.35). The examination of the impact of DHI on sedentary behavior across different age ranges, as outlined above, corresponds to Table 4.

Therefore, there is no significant relationship between DHI and sedentary behavior of college students within the age range of 23–27.

f) One-way ANCOVA: Sedentary Behavior (Age range: 18–22 and 23–27).

The F-value of 30.164 for the age range of 18–22 indicated a statistically significant difference in the sedentary behavior of the experimental group (M = 6.27, SD = 2.19) compared with the control group (M = 6.70, SD = 1.87), with 1/432 df. The between-subjects effect analysis results show that pretest (F = 512.880, $P < .001$, $\eta p^2 = 0.543$) and group (F = 30.164, $P < .001$, $\eta p^2 = 0.065$) were both significant predictors of posttest sedentary behavior. The overall model was significant (F = 262.179, $P < .001$, $\eta p^2 = 0.548$), accounting for 54.8% of the variance in posttest sedentary behavior in university students aged 18–22, with adjusted $R^2 = 0.546$. The intercept was also a significant predictor (F = 48.181, $P < .001$,

$\eta p^2 = 0.100$). The error term was estimated to be 1.902, with a total of 435 observations.

The between-subjects effect analysis for the age range of 23–27 shows that pretest was a significant predictor ($F = 72.24$, $P < .001$, $\eta p^2 = 0.538$), whereas the group was not a significant predictor ($F = 0.369$, $P = 0.546$, $\eta p^2 = 0.006$) of posttest sedentary behavior in university students aged 23–27 when adjusted for each other. This indicates that there was no statistically meaningful distinction in the sedentary behavior values between the groups after the intervention, once the pretest scores were taken into account. The overall model was significant ($F = 36.386$, $P < .001$, $\eta p^2 = 0.54$), accounting for 54% of the variance in posttest sedentary behavior in university students within the age range of 23–27, with adjusted $R^2 = 0.525$. The intercept was also a significant predictor ($F = 15.389$, $P < .001$, $\eta p^2 = 0.199$). The error term was estimated to be 1.664, with a total of 65 observations.

Discussion

The current study showcases the effectiveness of a health intervention-based application in reducing sedentary behavior among university students while considering the influence of age and gender. The findings indicate that such applications can be valuable in promoting positive health behaviors, specifically in addressing sedentary behavior. The experimental group exhibited a noteworthy reduction in average sedentary behavior (M_pre = 6.84 to M_post = 6.26) due to their participation in the DHI. These results highlight the potential of utilizing technology-based interventions to improve health outcomes related to sedentary behavior. The findings are consistent with a previous study conducted by Kellner and Faas (2022), highlighting the significant relevance of digital interventions in effectively reducing sedentary behavior.[8] The current intervention's incorporation of participant-driven goal setting was instrumental in facilitating a more realistic and achievable target. This approach aligns with the suggestions made by participants in the study conducted by Martinez-Calderon *et al.* (2020).[32]

The discovery that DHIs have a significant impact on lowering sedentary levels following participation provides corroborative evidence in line with recently published research.[33-37] While previous studies centered around specific populations, such as adolescents,[35,36] patients,[37] women,[33] and older individuals,[38] the present study uniquely targeted college students, expanding the scope of research in this domain.

The increased autonomy and independence experienced by college students often contribute to a heightened susceptibility to adopt unhealthy behaviors stemming from challenges in self-regulation and self-efficacy.[39,40] Given this perspective, numerous trials of e-health interventions have incorporated self-efficacy as a fundamental theoretical element.[40-42] With advancements in technology, the capabilities of smartphones are expanding, providing many convenient opportunities for health behavior change interventions. Website-based interventions offer comprehensive information and foster holistic engagement, which is likely the key driving factor behind their remarkable effectiveness.[43,44] Participants often reported enhanced physical activity awareness and positive changes in their attitudes toward personal goal setting.[44,45] Technological interventions have demonstrated their potential in promoting physical activity and well-being across clinical populations and mixed populations.[46-53] These interventions have shown promise in addressing a spectrum of health conditions, such as diabetes, cardiovascular diseases, and mental health disorders, by facilitating behavior change and encouraging active lifestyles.

Additionally, the use of technology in health promotion extends beyond medical conditions to encompass maternal health. A study, conducted by Kiani and Pirzadeh[54] (2021) centered around pregnant women, successfully utilized a mobile application-based intervention to foster positive health behavior changes and promote physical activity during pregnancy. The findings underscore the relevance of personalized digital interventions in supporting expectant mothers' health and well-being, while offering a scalable approach to address the unique challenges faced during this critical life stage.[55-57]

In the present study, subgroup analysis revealed that the DHI significantly reduced sedentary behavior in both males and females. This is consistent with the outcomes of the study conducted by Peng *et al.*[19] (2022), emphasizing how e-health interventions have a notable and positive impact on increasing physical activity levels across both genders and are associated with reductions in total sedentary behavior. This finding underscores the potential effectiveness of DHI as a valuable tool for addressing sedentary behavior issues across a diverse population. However, the sedentary levels for the age range of 23–27 did not exhibit a significant decrease due to participation in the DHI. Age as a correlate of sedentary behavior or time displays a mixed pattern and appears to be contingent on the type of sedentary behavior under consideration, such as computer use versus television viewing,[58,59] whereas the elderly population is commonly linked to elevated levels of sedentary behavior. The presence of greater freedom and independence is often associated with an elevated susceptibility to adopting unhealthy health behaviors among college students. This is linked to a perceived

lack of self-control and self-efficacy among these individuals.[39,60]

Over the past decade, there has been a growing interest in behavioral change interventions aimed at enhancing physical activity levels and reducing sedentary behavior.[61] Nevertheless, it is recommended that future researchers consider employing a hybrid intervention approach, as several studies[34,62,63] have consistently shown that combining multiple intervention modes yields better outcomes compared with using a single intervention mode. Hybrid interventions, which integrate various strategies, such as digital platforms, personalized coaching, and in-person sessions, offer the advantage of targeting different aspects of behavior change and engaging participants through diverse channels.[64,65]

Given the recent global pandemic that prompted significant lifestyle changes for people of all ages, digital interventions have gained particular importance. With a shift toward more sedentary alternatives for work and leisure activities, accompanied by increased screen time, digital interventions play a crucial role in addressing and reducing sedentary behaviors. An increase in remote studies, which were conducted to implement management strategies for sedentary behavior, was observed.[44-70] Given the notable rise in sedentary behaviors and the increasing prevalence of obesity,[71] there is a compelling need for research on interventions that promote active and healthier lifestyles. Continual research is warranted to regularly update the data pertaining to the physical activity levels of school-age children, adolescents, and adults, as well as their respective sedentary behaviors.

Limitation and recommendation

The current study has certain limitations that should be addressed. The study's scope could be extended to include colleges in semi-urban and rural areas, enabling a more comprehensive understanding of prevailing trends in sedentary behavior among university students. Future studies may benefit from expanding the assessment parameters and techniques (use of objective assessment techniques, such as accelerometers and pedometers) to encompass a broader range of variables.

Conclusion

The study explored the effectiveness of a mobile application-based DHI in reducing sedentary behavior among university students. The findings revealed distinct subgroups within Indian universities that exhibited a higher propensity for engaging in unhealthy behaviors, with females demonstrating higher levels of sedentary behavior than males and students within the age range of 18–22 showing increased sedentary behavior. However, further investigation is needed to explore the long-term maintenance of sedentary behavior reduction. The use of e-health interventions and DHIs has emerged as a promising approach in college settings, with educators and health practitioners encouraged to embrace this trend and explore the psychological factors influencing health behavior change among college students. Integrating smartphone apps, Internet resources, monitoring tools, and social media can facilitate the development of tailored e-health interventions with personalized components.

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Ethical consideration

This study was approved by the Ethics Committee of Pandit Deendayal Energy University (Research Ethics Code: ODRD/EC/2023/17/04). The participants were comprehensively briefed on the study's objectives and methodology.

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Conflict of interest

There are no conflicts of interest.

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