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Original Article

Factors associated with changes in physical activity and sedentary behaviour during one year among university-based young adults

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ABSTRACT

The purpose of this study was to identify correlates of changes in physical activity (PA) and sedentary behaviour (SB) among university-based young adults in Bangladesh. Data were from a 1-year prospective study with 2 assessment points (baseline n = 573, 20.7 ± 1.35 years, 45% female; retention rate 69%, analytical sample = 395). Participants completed a self-administered written survey on PA, SB, health and lifestyle behaviours, and sociodemographics. Changes in PA were categorised as: negligible (± < 60 min/week), > 60 min/week decrease, or > 60 min/week increase. Changes in SB were categorised as negligible (± < 120 min/week), > 120 min/week decrease, and > 120 min/week increase. Multinomial logistic regression analysis was used to identify the correlates. About quarters (72%) of participants had insufficient PA at both assessment points. Of those who were sufficiently active at Wave 1, 5% became insufficiently active at Wave 2. One quarter of participants (23%) had high SB at Wave 1 and Wave 2. Of those who had low SB at Wave 1, 16% had high SB at Wave 2. Being male [*OR* = 2.04 (95% *CI*: 1.06–3.93)], baseline phone time of > 2 h/day [*OR* = 3.14 (95% *CI*: 1.04–7.04)] and not participating in organised sports at baseline [*OR* = 2.56 (95% *CI*: 1.24–5.29) were associated with a decrease in PA by > 60 min/week. Participants who frequently experienced stress at baseline had higher odds of increasing SB by > 120 min/day [*OR* = 1.83 (95% *CI*: 1.04–3.23)]. SB is more variable than PA over 1 year in university-based young adults in Bangladesh. Males, those with high phone time, those not engaging with organised sports, and those with frequent stress may change to a more inactive lifestyle.

Introduction

Physical activity (PA) participation among young adults can provide myriad health benefits such as lower cardiometabolic risk factors of non-communicable diseases (NCD) and help with weight maintenance.[1,2] Young adults who participate in sufficient PA have been found to have better psychosocial and cognitive health, including lower levels of anxiety and depression and higher self-esteem and life satisfaction than their inactive counterparts.[3–5] Emerging evidence also suggests that prolonged sedentary behaviour (SB), such as sitting and screen time, is associated with chronic health conditions including cardio-metabolic disorders, overweight and obesity, stress, sleep difficulties, anxiety, and depressive disorders among young adults.[6–9]

PA decreases during late adolescence, especially for leisure-time sports and active transport.[10–12] Because of modernisation, labour-saving technologies, advances in transportation, and increased availability of and access to screen-based entertainments, contemporary young adults spend a significant amount of time in different sedentary pursuits.[13] The increase in SB also continues over adulthood.[14–17] Being at university may affect PA and SB among young adults. For example, there may be new opportunities for PA via campus organised sports and social networks. However, academic commitments may prolong SB for study and reduce the discretionary time for PA.

Most correlate studies of PA and SB have used cross-sectional data.[12,14,18–20] However, the correlates of current behaviour may not be the same as the factors associated with the change of that behaviour over time.[21] A few studies have assessed factors associated with the change in PA among adolescents.[22–24] Male gender and greater outdoor exposure were associated with an increase,[22,24] and low family income

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List of abbreviations

BDT	Bangladeshi Taka (Bangladeshi local currency)
BMI	body mass index
CI	confidence interval
GPAQ	Global Physical Activity Questionnaire
LMIC	low- and middle-income country
NCD	non-communicable disease
OR	odds ratio
PA	physical activity
SB	sedentary behaviour
USD	United States dollar
WHO	World Health Organization

and a higher level of body mass index (BMI) were associated with a decrease[23,24] in adolescents PA over time. There is, however, little evidence on young adults, and we are not aware of studies that have looked at the change in both PA and SB.

Young adulthood represents a major transition from adolescence to adulthood. This transition can negatively affect PA participation and engagement in different sedentary pursuits among young adults and can have concurrent and future health implications. Though PA and SB are 2 distinct behaviours, they can co-occur, and both may have adverse health consequences for young adults. Understanding the factors associated with PA and SB change can help identify those at risk of adopting an unhealthy lifestyle, and therefore, adverse health and wellbeing outcomes. Hence, the current study aimed to identify the factors associated with the change in PA and SB over 1 year among university-based young adults in Dhaka, Bangladesh.

Methods

Study population and design

Data were from a 1-year prospective study with 2 assessment points. During Wave 1 (September to December 2015), a convenience sample of first, second, and third-year students (18–24 years) were recruited from 6 universities (3 public and 3 private) in Dhaka, Bangladesh. Details of the recruitment procedure can be found elsewhere.[25] Participating students completed a self-administered written survey with questions about PA, SB, psychological and social factors (e.g., stress, social support), health and lifestyle behaviours (e.g., weight, cigarette smoking), and sociodemographic factors. Participants completed Wave 1 survey in approximately 40–45 min. In 2016 (October to November 2016), the students were followed up with a survey that included questions on PA and SB and took about 15–20 min to complete.

Ethical approval statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The University of Queensland Behavioural and Social Sciences Ethical Review Committee, Australia, provided ethical approval for the study (Ref: 2015000860; Amendment- 31/07/2015; Amendment 29/09/2016). Informed consent was obtained from all individual participants included in the study.

Outcome variables – changes in physical activity and sedentary behaviour

PA was measured with the Global Physical Activity Questionnaire (GPAQ).[26] Participants were asked whether they engaged in regular PA for each of at work, during transportation and leisure for at least 10 min continuously, and if so, the number of days in a typical week, and how much time on a typical day. This information was used to compute PA times in each of the 3 domains, which were then summed to generate total PA in min/week.[27] For descriptive purposes, PA was categorised as 'insufficient' ($<$ 150 min/week) and 'sufficient' ($\geq$ 150 min/week); this criterion is consistent with World Health Organization's (WHO) PA recommendations for adults.[27] To examine changes in PA over one year, Wave 1 PA time (min/week) was subtracted from Wave 2 PA time. These data were categorised into 1 of 3 groups: negligible change $\pm \leq$ 60 min/week increase/decrease in physical activity; decreased by $>$ 60 min/week and increased by $>$ 60 min/week.

To assess SB, a modified version of the GPAQ was used to fit the needs of the current study. The original GPAQ has 1 item on SB asking about time spent sitting/reclining "*at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling by car, bus, train, reading, playing cards or watching television, but do not include time spent sleeping in a typical day of the week*".[28] As adolescents in Bangladesh reported significantly more screen-time (the most common type of SB among adolescents) during weekend days than on weekdays,[29] the single-item question of the GPAQ was split into two in the current study to ask about SB in a typical weekday and a weekend day using the same GPAQ wording. Daily sedentary time was derived from the weekend day and weekday SB data. For descriptive purposes, SB was dichotomised as high ($>$ 480 min/day) and low ($\geq$ 480 min/day). This cut-off has been used in other research with Asian adults,[30] and has been shown to increase the risk of all-cause mortality significantly.[31] To examine changes in SB over 1 year, Wave 1 SB time (min/day) was subtracted from Wave 2 SB time. These data were then categorised into one of three groups: negligible change $= \pm \leq$ 120 min/day; increase by $>$ 120 min/day, and decrease by $>$ 120 min/week.

Following the WHO GPAQ scoring protocol,[32] 2 respondents at each wave ($n = 4$) were excluded from the analyses as they provided improbable or out-of-range PA data.

Explanatory variables

Sociodemographic, health, and lifestyle variables measured at Wave 1 were considered as possible factors associated with the change in PA and SB. PA-specific psychological and social factors measured at Wave 1 were considered as predictors of change in PA only.

Sociodemographic factors

The sociodemographic factors included age (dichotomised as 18–20 years and 21–24 years age groups); gender; marital status; each of parent's highest education attainment; mother's employment status; father's occupation; university type; monthly gross household income; living arrangement and type of accommodation; and having a television and/or computer in the bedroom.

Health and lifestyle factors

The health factors included frequency of experiencing each of anxiety, depression, stress, sleep difficulties, perceived health, life satisfaction, and BMI. The lifestyle factors included cigarette smoking; alcohol consumption; dietary behaviour (e.g., frequency of fast food, fruit, sugary drinks; breakfast skipping); participation in organised sports at university or outside the university.

PA specific psychological and social variables

PA efficacy was measured with 5 items using a 4-point Likert scale for responses. Items asked about confidence overcoming barriers to PA if they had worries, felt depressed, felt tense, felt tired, and were too busy to do PA.[33] An exploratory factor analysis with varimax rotation offered a 1-factor solution that accounted for 52% variance, with Cronbach's α being 0.85. Scores were summed, and a total PA efficacy score (range: 5–20) was generated, with high scores representing high efficacy.

PA outcome expectations were assessed using 5 items from the Benefits of Physical Activity scale[34] to assess anticipated benefits of regular PA, including improving physical fitness, appearance, and overall health, helping with weight management, and reducing the risk of poor health. Responses were recorded on a 5-point Likert scale. An exploratory factor analysis with varimax rotation confirmed the unidimensionality of the 5 items with a 1-factor solution that accounted for 56% of the variance, with Cronbach's α being 0.79. Scores were summed to generate an outcome expectations score (range: 5–25), with high scores representing positive outcome expectations.

The perceived importance of PA was measured with a single item. Participants were asked to indicate how important they think PA in their life on a 6-point Likert scale, with the responses options of 0 = 'not at all important'; 1 = 'somewhat unimportant'; 2 = 'neutral'; 3 = 'somewhat important'; 4 = 'important'; and 5 = 'very important'. The scale was adapted from Wójcicki et al.,[35] which originally recorded responses in a 5-point Likert scale ranging from 1 = 'not at all important' to 5 = 'very important'.

Ten items from the Social Support for Exercise Survey Scale[36] were used to measure social support for PA. Participants used a 5-point Likert scale to indicate how often they received PA support from their family/friends (e.g., did PA with the participant, encouraged, complained about their PA). An exploratory factor analysis with varimax rotation confirmed the unidimensionality of the 10 items with a 1-factor solution accounting for 91% of the variance with Cronbach's α being 0.87. The item scores were summed to generate a total PA social support score (range: 6–36; one item was reverse-scored), with high scores representing a high level of social support for PA.

Statistical analyses

To identify the correlates of changes in PA and SB, 1-year prospective data were used. The outcome variables (changes in PA and SB) had 3 categories (negligible change, decrease and increase). Therefore, multinomial logistic regression analysis was used to identify correlates of changes in PA and SB. Explanatory variables which had univariate associations with the outcome variable at $\leq$ 20% significance level (as recommended elsewhere[37]) were identified and examined for collinearity. Outliers and other assumptions of the models were checked, and model fit was assessed before finalising the model. Variables, which did not have significant associations with the outcome variable of interest in the multivariable model at 5% level of significance, were excluded.

The modelling of three categories for PA changes involved estimation of the following 2 equations:

i) The likelihood of '*decrease*' in PA over 1-year vs the likelihood of '*negligible change*', and
ii) The likelihood of '*increase*' in PA over 1-year vs the likelihood of '*negligible change*'.

The modelling of three categories for SB changes involved estimation of the following 2 equations:

i) The likelihood of '*increase*' in SB over 1-year vs the likelihood of '*negligible change*', and
ii) The likelihood of '*decrease*' in SB over 1-year vs the likelihood of '*negligible change*'.

All analyses were performed in Stata version 14 (StataCorp LP., College Station, Texas) with statistical significance set at $p < 0.05$. Only significant factors associated with change are presented as odds ratios (*OR*) with their 95% confidence intervals (*CI*).

Results

Participants

A total of 575 students completed the Wave 1 survey. Two of Wave 1 participants were excluded as they provided incomplete data on PA. Among 573 students who participated in Wave 1, 397 completed Wave 2 survey. However, 2 participants provided incomplete data at Wave 2 and were excluded. Thus, the analytical sample of this study was 395.

Just over half of the participants (51.9%) who participated in both assessment points were female; the majority were single (92.4%), had healthy BMI (62.8%), and were studying in private universities (58.7%). Seventy-nine percent of the participants' mothers were stay-at-home, 33.7% had a mother with tertiary education, and 60.2% reported their father had tertiary education. The majority of the students (79.0%) were

Table 1
Characteristics of the participating young adults in Dhaka, Bangladesh, 2015–2016, (n = 395)[a].

Characteristics	*n*	%
Age (years)		
18-20	184	46.6
21-24	211	53.4
Gender		
Male	190	48.1
Female	205	51.9
Marital status		
Single	365	92.4
Married or others	30	7.6
BMI		
Underweight	91	23.0
Healthy weight	248	62.8
Overweight	56	14.2
University type		
Public	163	41.3
Private	232	58.7
Mother's educational qualification		
Up to secondary (or equivalent)	178	45.1
Higher secondary (or equivalent)	84	21.3
Tertiary (or equivalent)	133	33.7
Father's educational qualification		
Up to secondary (or equivalent)	75	19.0
Higher secondary (or equivalent)	82	20.8
Tertiary (or equivalent)	237	60.2
Mother's employment status		
Working	83	21.1
Stay-at-home	310	78.9
Father's occupation		
Government/public service	103	27.9
Non-government/private service	63	17.1
Professional	31	8.4
Self-employed/business	139	37.7
Farmer/day labourer	33	8.9
Monthly gross family income (in BDT)*		
$\leq$ 20,000	74	19.0
20,001–40,000	98	25.1
40,001–70,000	125	32.1
$>$ 70,000	93	23.9
Living arrangement		
Living alone	15	3.8
Living with parents (or other family members)	237	60.2
Living with friends	142	36.0
Accommodation type		
University accommodation (i.e., dormitory)	83	21.0
Outside university	312	79.0

[a] n = 395 includes those who participated in both Waves.
* BDT=Bangladeshi Taka (local currency); 10,000 BDT = 120.52 United States dollar (USD) as of 29 Apr. 2018.

living outside the university accommodation, and 60.2% were living with their families. Characteristics of students who participated in both waves are presented in Table 1.

Physical activity

As shown in Fig. 1, of the 395 students who participated in both waves of the study, just less than 3 quarters (72%) remained insufficiently active at both assessment points, with more females insufficiently active than males. One in 10 (10%) participants who had insufficient PA at Wave 1 became sufficiently active at Wave 2, with more males (12%) than females (8%) becoming sufficiently active at Wave 2. Overall, 5% of the participants who had sufficient PA at Wave 1 became insufficiently active at Wave 2, with fewer females (2%) than males (8%) becoming insufficiently active at Wave 2. Overall, 13% were sufficiently active at both waves, with more males sufficiently active than females.

Gender, age range, mother's occupation status, father's education, computer in the bedroom, social support for PA, PA efficacy, perceived importance of PA, organised sports participation, perceived health, sleep difficulties, vegetable consumption, daily phone time, and SB had a univariate association with PA change at 20% level of significance. Male gender, > 2 h/day phone time, and no organised sports participation were associated with a decrease in PA by > 60 min/week in the multivariable model. Participants who had a stay-at-home mother had twice the odds of increasing PA by > 60 min/week (Table 2).

Table 2
Factors associated with 1-year change in physical activity among university-based young adults in Dhaka, Bangladesh, 2015–2016 ($n = 395$)[a].

Characteristics	> 60 min/week decrease vs. ± ≤ 60 min/week change in PA		> 60 min/week increase vs. ± ≤ 60 min/week change in PA	
	OR (95% *CI*)	*p*-value	*OR* (95% *CI*)	*p*-value
Gender				
Female	Ref		Ref	
Male	2.04 (1.06–3.93)	**0.032**	0.99 (0.57–1.73)	0.976
Stay-at-home mother				
No	Ref		Ref	
Yes	1.09 (0.53–2.27)	0.808	2.26 (1.09–4.70)	**0.029**
Phone time				
≤ 1h/day	Ref		Ref	
1–2 h/day	0.77 (0.35–1.70)	0.523	0.96 (0.52–1.77)	0.907
> 2 h/day	2.11 (1.01–4.41)	**0.048**	0.82 (0.38–1.78)	0.615
Organised sports participation				
Yes	Ref		Ref	
No	2.56 (1.24–5.29)	**0.011**	1.55 (0.74–3.24)	0.242

Values in bold indicate *p*-value < 0.05.
Note: Initial model included variables that had a univariate association with the outcome variable at 20% level of significance. Variables were removed from each of the models until only variables with a *p*-value < 0.5 remained. **Abbreviations**: *OR* = odds ratio; *CI* = confidence intervals; PA = physical activity.
[a] $n = 395$ includes those who participated in both Waves.

Sedentary behaviour

About 1 quarter of the participants (23%) had high SB at both waves, with more females than males. Onequarter of participants (25%) who had high SB at Wave 1 had low SB at Wave 2, with the percentage similar for males and females at Wave 2. Just over 1-third of participants (36%) had low SB (< 480 min/day) at both waves, with more young adult males than females. Overall, 16% of the participants who had low SB at Wave 1 had high SB at Wave 2, with a similar percentage between females and males (Fig. 2).

BMI, father's occupation, frequency of stress, current cigarette smoking, low vegetable consumption, not meeting the WHO PA recommendation of ≥150 min/week, and skipping breakfast had a univariate association with change in daily SB at 20% level of significance. Being overweight and meeting the WHO PA recommendations were associated with a decrease in SB by > 120 min/day. Frequently experiencing stress was associated with an increase in SB by > 120 min/day. Table 3 presents factors, which were significantly associated with changes in SB in the multivariate models.

Discussion

To our knowledge, the current study is the first to identify the factors associated with the change in PA and SB among young adults in a low- and middle-income country (LMIC). Contemporary PA/SB research often focuses on cross-sectional correlates of these behaviours, and less attention has been paid to understand which factors are associated with changes in PA/SB over time. This information can help identify specific population groups who are at risk of compromising their activity behaviours and can be useful to design future interventions targeting PA and SB of young adults, especially in the context of LMICs. In this current study of university-based young adults, males and participants with high phone time and those who did not engage in organised sports at baseline were likely to decrease their weekly PA over 1 year. Young adults who frequently experienced stress at baseline had higher odds of increasing SB. In terms of change to a healthy lifestyle, university students with a

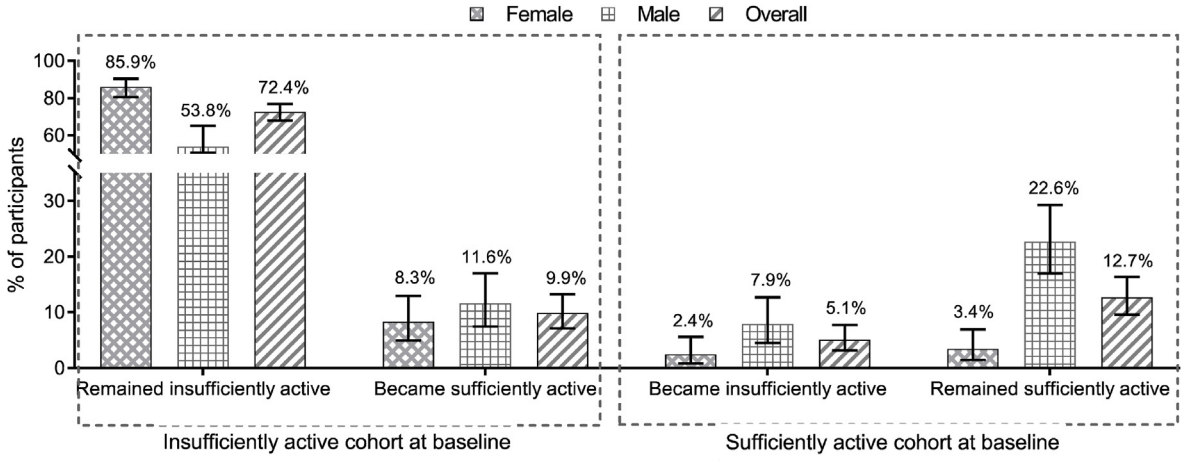

Fig. 1. Changes in meeting the World Health Organization's physical activity recommendations (≥ 150 min/week) across 1 year among young adults in Dhaka, Bangladesh, by gender, 2015–2016 ($n = 395$)[a].
[a] $n = 395$ includes those who participated in both Waves.
Note: Error bars represent 95 confidence intervals.

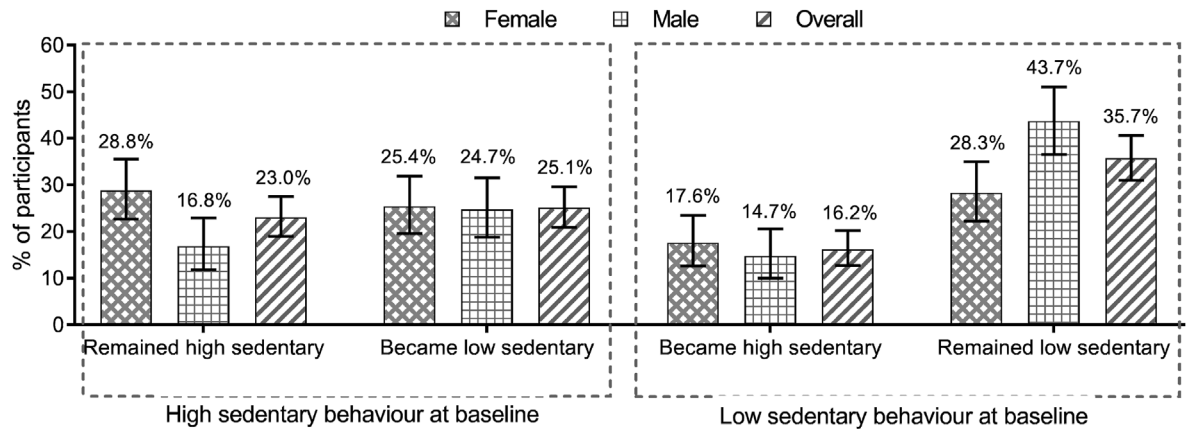

Fig. 2. Changes in sedentary behaviour (> 8 h/day) across 2 waves among young adults in Dhaka, Bangladesh, by gender, 2015–2016 (n = 395)[a].
[a] n = 395 includes those who participated in both Waves.
Note: Error bars represent 95 confidence intervals.

Table 3
Factors associated with 1-year change in sedentary behaviour among university-based young adults in Dhaka, Bangladesh, 2015–2016 (n = 395)[a].

Characteristics	Daily >120 min decrease vs. ± ≤ 120 min change		Daily > 120 min increase vs. ± ≤ 120 min change	
	OR (95% *CI*)	*p*-value	*OR* (95% *CI*)	*p*-value
BMI				
Healthy	Ref		Ref	
Underweight	1.39 (0.76–2.53)	0.286	1.46 (0.76–2.80)	0.252
Overweight	3.26 (1.64–6.47)	**0.001**	1.86 (0.81–4.30)	0.146
Experiencing stress				
Infrequently	Ref		Ref	
Frequently	1.36 (0.81–2.29)	0.247	1.83 (1.04–3.23)	**0.036**
Meeting the WHO physical activity recommendations				
No	Ref		Ref	
Yes	1.97 (1.07–3.65)	**0.030**	1.48 (0.72–3.03)	0.288

Values in bold indicate *p*-value < 0.05.
Note: Initial model included variables that had a univariate association with the outcome variable at 20% level of significance. Variables were removed from the models until only variables with a *p*-value <0.5 remained.
Abbreviations: *OR* = odds ratio; *CI* = confidence intervals; WHO=World Health Organization.
[a] n = 395 includes those who participated in both Waves.

stay-at-home mother were more likely to increase PA, and those who were overweight or meeting PA recommendations were more likely to decrease SB over the year.

In the entire sample, 85% of the participants' maintained their PA status over the year, with 72% remaining insufficiently active and 13% remaining sufficiently active at both assessment points based on the WHO PA recommendations of ≥150 min/week.[27] Of those who were sufficiently active at Wave 1, 5% became insufficiently active. The findings that a vast majority of the participants remained insufficiently active, and some became insufficiently active is consistent with the evidence that physical activity declines from leaving high school to entering university, which continues during university years.[38] For example, meta-analytic evidence suggests that during the transition from high school to university, PA decreases by 7.04 min/day over a mean of 0.8 years of follow-up[38] and by 5.2 min/day from adolescence to adulthood over a mean of 3.4 years of follow up.[12] Notably, overall, 59% of the participants maintained their SB status, with 36% of participants remaining low SB and 23% remaining high SB at both assessment points. Over one year, 16% of participants who had low SB at Wave 1 had high SB at Wave 2. The findings of the current study, therefore, suggest that SB is more variable than PA among university-based young adults in Bangladesh. This may reflect that PA status among young adults is more habitual than SB. In addition, SB includes a broader range of behaviours, with recreational and non-recreational activities, which could increase variability.

PA decrease was more common among males than females, those with a high phone time, and those not engaging with organised sports. Males had twice the odds of decreasing PA by more than 60 min/week over the year. A greater decline in PA among males than females during the transition from adolescence to young adulthood has been documented previously.[38] For example, evidence from systematic review and meta-analysis[38] suggest that during their transition from high school to university, males' PA decline by 16.35 min/day over a mean follow-up of 0.8 years, which is considerably greater than the decline of PA in females (6.61 min/day). In our study, however, a higher number of males than females were sufficiently active at both Wave 1 (27% vs. 6%) and Wave 2 (34% vs. 12%). In general, the male gender is positively associated with PA regardless of country or age group.[18] Participants who had a high phone time of >2 h/day had higher odds of decreasing their PA over the year. Phone conversations tend to be sedentary, which can displace and decrease PA time. Engaging in high phone time may also suggest the prioritisation of social activities. Young adults who did not participate in organised sports were more likely to decrease their PA over the year. This is understandable as organised sports can create a PA-friendly environment for young adults. Organised sports can also provide a social network, which can be important for adopting and maintaining different health-enhancing behaviours.[39,40]

Participants who frequently experienced stress had higher odds of increasing daily sedentary time. This supports the current literature that poor psychological health is associated with high SB among university-based young adults[7–9] and in the general population.[14,15] This relationship, however, could be bidirectional.[41] While people can be sedentary in response to high levels of stress, it is also possible that a sedentary lifestyle contributes to stress, poor psychological functioning, disturbed sleep, anxiety, and depression.[41,42] More research is needed to understand the causal pathways of stress and SB. Findings suggest that students who had a stay-at-home mother were more likely to increase their PA over 1 year. This finding is inconsistent with previous literature that found parental occupation, including mother's occupation, to be positively associated with PA of children and adolescents.[43,44] Our findings also contrast a previous cross-sectional study with adolescents in Bangladesh[45] that reported a positive association between mother working and boys' PA and highlights the need to differentiate between correlates of current and change behaviour. University students spend a significant amount of time on campus. It is possible that when mothers stay at home, they have more time to provide support (e.g., encouragement, transportation) for PA. It would be interesting to assess how

parental occupation affects PA at different stages of life from childhood, adolescence, to young adulthood.

Overweight participants had higher odds of decreasing their daily sedentary time, which is inconsistent with other research indicating a positive association between BMI and SB.[14] It is possible that overweight students were more health-conscious and therefore trying to do less SB over time. However, the evidence for an association between different measures of adiposity, including BMI and SB, is mixed or inconsistent.[46] Findings that participants who met the WHO recommendations of PA were more likely to decrease their SB than those who did not meet the recommendations can be explained by time displacement.[47] As suggested in Behavioural Choice Theory[48] and time-use epidemiology,[49] 1 behaviour may compete with another during free time; time spent in 1 behaviour can affect and displace time for another. It is thus possible that participation in PA reduced time in SB. It may be that those who were physically active were less interested in sedentary pursuits such as recreational screen time.

The strengths of this study include the longitudinal design of the study, PA and SB measures that have been validated in Bangladeshi adults, a moderately large sample size, and a heterogeneous group of students representing both public and private universities. The study, however, has some limitations. Self-reported measures to assess PA and SB are vulnerable to social desirability and recall bias, and self-report of SB can be challenging given the incidental and varied nature of this type of behaviour. Sleep, an important component of the 24-h time-use,[50] was not measured in the current study. The use of a non-random sample of participants from conveniently selected universities in a metropolitan city may limit the generalisability of the findings.

Conclusions

The results of this study suggest that SB is more variable than PA among university-based young adults in Dhaka, Bangladesh, with more young adults maintaining their PA status than SB status. Males, participants with a high phone time, those not engaging in organised sports, and those with frequent stress were more at risk of compromising their activity behaviours. Research with more assessment points (to understand trajectory) and representative samples of young adults from metropolitan and regional areas are needed to confirm these findings.

Ethical approval statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The University of Queensland Behavioural and Social Sciences Ethical Review Committee, Australia, provided ethical approval for the study (Ref: 2015000860; Amendment- 31/07/2015; Amendment 29/09/2016). Informed consent was obtained from all individual participants included in the study.

Submission statement

The work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), it is not under consideration for publication elsewhere, its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere including electronically in the same form, in English or in any other language, without the written consent of the copyright-holder.

Authors' contributions

RU designed the study, collected and analysed data and drafted the manuscript; AK conceived and designed the study, analysed data and helped drafting the manuscript; NWB conceived and designed the study and helped drafting the manuscript. All authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors.

Conflict of interest

None to declare.

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References

1. Jakicic JM, King WC, Marcus MD, et al. Short-term weight loss with diet and physical activity in young adults: the IDEA study. *Obesity*. 2015;23(12):2385–2397. https://doi.org/10.1002/oby.21241.
2. Gordon-Larsen P, Hou N, Sidney S, et al. Fifteen-year longitudinal trends in walking patterns and their impact on weight change. *Am J Clin Nutr*. 2009;89(1):19–26. https://doi.org/10.3945/ajcn.2008.26147.
3. Korn L, Gonen E, Shaked Y, et al. Health perceptions, self and body image, physical activity and nutrition among undergraduate students in Israel. *PLoS One*. 2013;8(3), e58543.
4. Tyson P, Wilson K, Crone D, et al. Physical activity and mental health in a student population. *J Ment Health*. 2010;19(6):492–499. https://doi.org/10.3109/09638230902968308.
5. Rangul V, Bauman A, Holmen TL, et al. Is physical activity maintenance from adolescence to young adulthood associated with reduced CVD risk factors, improved mental health and satisfaction with life: the HUNT Study, Norway. *Int J Behav Nutr Phys Act*. 2012;9(1), 144. https://doi.org/10.1186/1479-5868-9-144.
6. Nanney MS, Lytle LA, Farbakhsh K, et al. Weight and weight-related behaviors among 2-year college students. *J Am Coll Health*. 2015;63(4):221–229. https://doi.org/10.1080/07448481.2015.1015022.
7. Feng Q, Zhang Q-l, Du Y, et al. Associations of physical activity, screen time with depression, anxiety and sleep quality among Chinese college freshmen. *PLoS One*. 2014;9(6), e100914. https://doi.org/10.1371/journal.pone.0100914.
8. Wu X, Tao S, Zhang S, et al. Impact of screen time on mental health problems progression in youth: a 1-year follow-up study. *BMJ Open*. 2016;6(11), e011533. https://doi.org/10.1136/bmjopen-2016-011533.
9. Wu X, Tao S, Zhang Y, et al. Low physical activity and high screen time can increase the risks of mental health problems and poor sleep quality among Chinese college students. *PLoS One*. 2015;10(3), e0119607. https://doi.org/10.1371/journal.pone.0119607.
10. Neumark-Sztainer D, Story M, Hannan PJ, et al. Factors associated with changes in physical activity: a cohort study of inactive adolescent girls. *Arch Pediatr Adolesc Med*. 2003;157(8):803–810. https://doi.org/10.1001/archpedi.157.8.803.
11. Van Dyck D, De Bourdeaudhuij I, Deliens T, et al. Can changes in psychosocial factors and residency explain the decrease in physical activity during the transition from high school to college or university? *Int J Behav Med*. 2015;22(2):178–186. https://doi.org/10.1007/s12529-014-9424-4.
12. Corder K, Winpenny E, Love R, et al. Change in physical activity from adolescence to early adulthood: a systematic review and meta-analysis of longitudinal cohort studies. *Br J Sports Med*. 2019;53(8):496–503. https://doi.org/10.1136/bjsports-2016-097330.
13. Biddle SJH, Brehm W, Verheijden M, et al. Population physical activity behaviour change: a review for the European College of Sport Science. *Eur J Sport Sci*. 2012;12(4):367–383. https://doi.org/10.1080/17461391.2011.635700.
14. O'Donoghue G, Perchoux C, Mensah K, et al. A systematic review of correlates of sedentary behaviour in adults aged 18–65 years: a socio-ecological approach. *BMC Public Health*. 2016;16(1), 163. https://doi.org/10.1186/s12889-016-2841-3.
15. Bauman AE, Petersen CB, Blond K, et al. The descriptive epidemiology of sedentary behaviour. In: Leitzmann MF, Jochem C, Schmid D, eds. *Sedentary Behaviour Epidemiology*. Cham: Springer International Publishing; 2018.
16. Smith L, Gardner B, Fisher A, et al. Patterns and correlates of physical activity behaviour over 10years in older adults: prospective analyses from the English Longitudinal Study of Ageing. *BMJ Open*. 2015;5(4), e007423. https://doi.org/10.1136/bmjopen-2014-007423.
17. Richardson A, King S, Garrett R, et al. Thriving or just surviving? Exploring student strategies for a smoother transition to university. A Practice Report. *Int J First Year High Educ*. 2012;3(2):87–93. https://doi.org/10.5204/intjfyhe.v3i2.132.

18. Bauman AE, Reis RS, Sallis JF, et al. Correlates of physical activity: why are some people physically active and others not? *Lancet*. 2012;380(9838):258–271. https://doi.org/10.1016/S0140-6736(12)60735-1.
19. Gordon-Larsen P, Nelson MC, Popkin BM. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. *Am J Prev Med*. 2004;27(4): 277–283. https://doi.org/10.1016/j.amepre.2004.07.006.
20. Prince SA, Reed JL, McFetridge C, et al. Correlates of sedentary behaviour in adults: a systematic review. *Obes Rev*. 2017;18(8):915–935. https://doi.org/10.1111/obr.12529.
21. Brug J, Oenema A, Ferreira I. Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. *Int J Behav Nutr Phys Act*. 2005;2(1), 2. https://doi.org/10.1186/1479-5868-2-2.
22. Dumith SC, Gigante DP, Domingues MR, et al. Predictors of physical activity change during adolescence: a 3·5-year follow-up. *Public Health Nutr*. 2012;15(12): 2237–2245. https://doi.org/10.1017/S1368980012000948.
23. Raudsepp L, Viira R. Changes in physical activity in adolescent girls: a latent growth modelling approach. *Acta Paediatr*. 2008;97(5):647–652. https://doi.org/10.1111/j.1651-2227.2008.00748.x.
24. Nader PR, Bradley RH, Houts RM, et al. Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA*. 2008;300(3):295–305. https://doi.org/10.1001/jama.300.3.295.
25. Uddin R, Khan A, Burton NW. Prevalence and sociodemographic patterns of physical activity among Bangladeshi young adults. *J Health Popul Nutr*. 2017;36(1), 31. https://doi.org/10.1186/s41043-017-0108-y.
26. Bull FC, Maslin TS, Armstrong T. Global Physical Activity Questionnaire (GPAQ): nine country reliability and validity study. *J Phys Act Health*. 2009;6(6):790–804. https://doi.org/10.1123/jpah.6.6.790.
27. WHO. Global Recommendations on Physical Activity for Health. Accessed September 3, 2021 http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf19.
28. Armstrong T, Bull F. Development of the World Health Organization Global Physical Activity Questionnaire (GPAQ). *J Public Health*. 2006;14(2):66–70. https://doi.org/10.1007/s10389-006-0024-x.
29. Khan A, Burton NW. Screen-based behaviors of adolescents in Bangladesh. *J Phys Act Health*. 2016;13(11):1156–1163. https://doi.org/10.1123/jpah.2015-0514.
30. Win AM, Yen LW, Tan KHX, et al. Patterns of physical activity and sedentary behavior in a representative sample of a multi-ethnic South-East Asian population: a cross-sectional study. *BMC Public Health*. 2015;15(1), 318. https://doi.org/10.1186/s12889-015-1668-7.
31. Chau JY, Grunseit A, Midthjell K, et al. Sedentary behaviour and risk of mortality from all-causes and cardiometabolic diseases in adults: evidence from the HUNT3 population cohort. *Br J Sports Med*. 2015;49(11):737–742. https://doi.org/10.1136/bjsports-2012-091974.
32. WHO. *Global Physical Activity Questionnaire (GPAQ) Analysis Guide*. Geneva, Switzerland: World Health Organization; 2012.
33. Schwarzer R, Renner B. Health-specific self-efficacy scales. *Freie Universität Berlin*. 2009;14:2009.
34. Sallis JF, Hovell MF, Richard Hofstetter C, et al. A multivariate study of determinants of vigorous exercise in a community sample. *Prev Med*. 1989;18(1):20–34. https://doi.org/10.1016/0091-7435(89)90051-0.
35. Wójcicki TR, Szabo AN, White SM, et al. The perceived importance of physical activity: associations with psychosocial and health-related outcomes. *J Phys Act Health*. 2013;10(3):343–349. https://doi.org/10.1123/jpah.10.3.343.
36. Sallis JF, Grossman RM, Pinski RB, et al. The development of scales to measure social support for diet and exercise behaviors. *Prev Med*. 1987;16(6):825–836. https://doi.org/10.1016/0091-7435(87)90022-3.
37. Maldonado G, Greenland S. Simulation study of confounder-selection strategies. *Am J Epidemiol*. 1993;138(11):923–936. https://doi.org/10.1093/oxfordjournals.aje.a116813.
38. Winpenny EM, Smith M, Penney T, et al. Changes in physical activity, diet, and body weight across the education and employment transitions of early adulthood: a systematic review and meta-analysis. *Obes Rev*. 2020;21(4), e12962. https://doi.org/10.1111/obr.12962.
39. Janssen I, Dugan SA, Karavolos K, et al. Correlates of 15-year maintenance of physical activity in middle-aged women. *Int J Behav Med*. 2014;21(3):511–518. https://doi.org/10.1007/s12529-013-9324-z.
40. Christakis NA, Fowler JH. The spread of obesity in a large social network over 32 years. *N Engl J Med*. 2007;357(4):370–379. https://doi.org/10.1056/NEJMsa066082.
41. Gunnell KE, Flament MF, Buchholz A, et al. Examining the bidirectional relationship between physical activity, screen time, and symptoms of anxiety and depression over time during adolescence. *Prev Med*. 2016;88:147–152. https://doi.org/10.1016/j.ypmed.2016.04.002.
42. Hamer M, Smith L. Sedentary behaviour and depression. In: Leitzmann MF, Jochem C, Schmid D, eds. *Sedentary Behaviour Epidemiology*. Cham: Springer International Publishing; 2018.
43. Ferreira I, Van Der Horst K, Wendel-Vos W, et al. Environmental correlates of physical activity in youth – a review and update. *Obes Rev*. 2007;8(2):129–154. https://doi.org/10.1111/j.1467-789X.2006.00264.x.
44. O'Donoghue G, Kennedy A, Puggina A, et al. Socio-economic determinants of physical activity across the life course: a "DEterminants of DIet and Physical ACtivity" (DEDIPAC) umbrella literature review. *PLoS One*. 2018;13(1), e0190737. https://doi.org/10.1371/journal.pone.0190737.
45. Khan A, Burton NW, Trost SG. Patterns and correlates of physical activity in adolescents in Dhaka city, Bangladesh. *Public Health*. 2017;145:75–82. https://doi.org/10.1016/j.puhe.2016.12.011.
46. Memon AR, Stanton R, To Q, et al. Sedentary behaviour research in adults: a scoping review of systematic reviews and meta-analyses. *J Sports Sci*; 2021. https://doi.org/10.1080/02640414.2021.1928382.
47. Rhodes RE, Blanchard CM. Time displacement and confidence to participate in physical activity. *Int J Behav Med*. 2011;18(3):229–234. https://doi.org/10.1007/s12529-010-9133-6.
48. Rachlin H, Kagel JH, Battalio RC. Substitutability in time allocation. *Psychol Rev*. 1980;87(4):355–374. https://doi.org/10.1037/0033-295X.87.4.355.
49. Pedišić Ž, Dumuid D, Olds ST. Integrating sleep, sedentary behaviour, and physical activity research in the emerging field of time-use epidemiology: definitions, concepts, statistical methods, theoretical framework, and future directions. *Kinesiology*. 2017;49(2):252–269.
50. Memon AR, Gupta CC, Crowther ME, et al. Sleep and physical activity in university students: a systematic review and meta-analysis. *Sleep Med Rev*. 2021;58:101482. https://doi.org/10.1016/j.smrv.2021.101482.