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ORIGINAL ARTICLE

The art of forming habits: applying habit theory in changing physical activity behaviour

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Abstract

Background Habits are obtained as a consequence of cue-contingent behavioural repetition. Context cues stimulate strong habits without an individual contemplating that action has been initiated. Because of its health-enhancing effects, making physical activity a part of one's life is essential. This study examined the associations of physical activity (PA) behaviours with PA habits and the role of autonomous motivation in developing PA habits.

Methods This study used a cross-sectional design. A structured questionnaire was implemented through emails to 226 university students, where PA levels, habits and autonomous motivation were self-reported.

Results Binary logistic regression identified age groups, gender and participants who were trying to lose weight as the significant predictors in meeting physical activity guidelines. Path analysis showed that moderate-intensity physical activity ($\beta = 0.045$, CI = 0.069–0.248) and strength training exercises ($\beta = 0.133$, CI = 0.148–0.674) were significantly associated with PA habits ($p < 0.01$). Autonomous motivation was directly associated with PA habits ($\beta = 0.062$, CI = [0.295–0.541], $p < 0.01$) and was also significantly related to moderate-intensity physical activity ($\beta = 0.243$, CI = [0.078–0.266], $p < 0.01$) and strength training exercises ($\beta = 0.202$, CI = [0.033–0.594], $p < 0.05$).

Conclusions The emphasis on experiment-based logic and interest in habit formation in the research community is extensive. As the college years offer an excellent opportunity to establish healthy behavioural interventions, encouraging students in regular PA and exhibiting an autonomous motivation towards PA may be necessary.

Keywords Physical activity · Habits · Autonomous motivation · Behaviour change

Abbreviations

PA	physical activity
SRHI	self-report habit index
MPA	moderate-intensity physical activity
VPA	vigorous-intensity physical activity
CDC	Centers for Disease Control and Preventions

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Background

Emerging adulthood is a developmental period spanning between adolescence and adulthood. During this period, young adults pass many transitions, and unlike academic performances, financial self-sufficiency, developing their career, preparing the ground for adult lives are the most challenging risks (Maher et al. 2013). Unfortunately, at this time, engaging in active behaviours such as physical activity has been demonstrated to be a detrimental parameter. Regular exercise improves physical health, including significant cognitive benefits, by mitigating the risks of chronic diseases (Oakley et al. 2021). Such contradictory effects like time constraints, academic workloads and lack of motivation lead to unhealthy practices (Melnyk et al. 2014; Nelson et al. 2009). Physical activity has been conceptualised as a broad term that includes several dimensions, such as exercise, sport and leisure activities. It is often considered

a behaviour that is more like a habit, distinctly when regularly physically active. Changing behaviour can be complex because people are creatures of habit, and the things they do are the behaviours they want to do. To change the desired behaviour, identifying the cue with conscious control each time it is performed or be performed in a different context on each occasion is essential (Orbell and Verplanken 2010).

Habits, defined as the well-learned interrelation between cues and the representation of a particular behaviour, are considered critical factors in regulating physical activity (Gardner 2015). Habits, by their nature, can ensure that new desired behaviours will be enacted consistently without being forgotten. However, new habits develop relatively slowly and require a specific set of circumstances to be met that are favourable to habit formation (Lally et al. 2010). Physical activity is not just the manifestation of a person's intentions and beliefs; instead, it is related to self-reported habit strength (Rebar et al. 2016), and people with more vigorous habits for instigating bouts of physical activity are more likely to engage in being physically active (Phillips and Gardner 2016). People often use voluntary and goal-directed explanations to perform habits, which fails to guide actual performance (van der Weiden et al. 2020). The initiation of complex behaviours such as physical activity can become habitual, as a non-conscious, automatic response to an associated cue; however, their performance requires more reasoned and deliberative input, regardless of whether they have been constrained through a habitual impulse (Gardner 2015; Gardner et al. 2016). Forming a new habit influences a part of the brain called the basal ganglia, suggesting many rewards when performance contexts remain stable; thereby, changing habits requires changing beliefs, perceptions and cognitive strategies (reminders) (Carden and Wood 2018).

Habits are acquired via behavioural repetition in specific cue contexts (Orbell and Verplanken 2010); because of this discontinuity hypothesis, avoiding contextual cues from one's environment makes habits less intense (Verplanken et al. 2008). The intentional process primarily determines the initiation of behaviour, reflecting on rewarding acting and anticipated outcomes (Wood and Neal 2007). With repeated exposure to the behaviour in stable contexts, behavioural control shifts towards automatic, and the instigation of that behaviour acquires the features of a habit, for example, efficient, non-conscious and non-intentional (Hagger 2019). Research has shown solid behavioural habits are provoked by context cues without the notion of an individual intending that action has been initiated, thus keeping constant 'target' and 'action', an individual engages in such behaviour in the same place or the presence of a single cue (McCloskey and Johnson 2019). Habit theory-based behaviour change intervention studies found that implementing intention in a particular cue context increases habit strength and behavioural frequency (Beeken et al. 2017; Kaushal and Rhodes 2015). A narrative review of 15 intervention studies found cue-context repetition and action planning to encourage engagement in health-promoting behaviours as vital components of habit theory (Gardner and Rebar 2019). Moreover, a study conducted on a group of self-defined social drinkers measuring self-reported drinking habits showed that drinking behaviour was positively enacted as a rising drinking habit strength (Albery and Spada 2021).

Autonomous motivation is an engaging behaviour that is perceived to be consistent with self-endorsed reasons for action, such as a sense of choice, interest and satisfaction likely to play an essential role in habit formation (Ryan and Deci 2017). Theoretically, autonomous motivation may promote habit development through (a) directly, (b) indirectly via increased behavioural repetition and (c) interactively by strengthening the effect of behaviours. Hence, autonomous motivation is positively and directly associated with PA habits (Gardner and Lally 2013), increasing engagement in physical activity (Ntoumanis et al. 2021). Repeated sequential presentation of context, behaviour and rewarding outcomes with motivation increases action cues (Wood and Neal 2007). Autonomous motivation is required in augmenting habits; its effect could not be attributed to motivation strength (i.e. intention) but rather to the beliefs, expectations and attitudes (de Wit and Dickinson 2009).

Habit theory development and its application require robust habit measures. Automaticity is the 'active ingredient' of the effects of habit on the action (Gardner et al. 2012a, b). In contrast, it has been contended that self-reports of automaticity are unreliable as automatic action occurs without individuals' conscious awareness (Sniehotta and Presseau 2011). Habits have traditionally been estimated using past behaviour frequency in self-report surveys; however, behaviour frequency alone cannot differentiate habitual action (Ajzen 2002). The most frequent measure of habit strength is assessed by employing the 12 items self-report habit index (SRHI) instrument that reflects on three proposed habit facets: automaticity, performance frequency and relevance to self-identity. The SRHI sidesteps concerns about self-reporting habits by focusing on everyday experiences of automaticity, such as efficiency ('…I have no need to think about doing'), lack of awareness ('…I start doing before I realise I am doing it') and uncontrollability ('…I would find hard not to do') (Verplanken and Orbell 2003). The SRHI has covered any hypothesised habit-behaviour effects. Nonetheless, self-identity is not an essential component of habit (Gardner et al. 2012a, b), and behavioural frequency indicators raise the actual effects of automaticity (Gardner et al. 2012a). As such, a subset of four automaticity SRHI items, called SRBAI (Self-Report Behavioural Automaticity Index), has

been identified to show expected effects (Gardner et al. 2012a). Our study adopted all 12-SRHI items because of their excellent psychometric properties and a wide variety of use in many behavioural contexts.

The term 'habit' as a changing behaviour tool is less commonly mentioned in developing countries' research contexts. Habit interventions are a powerful determinant for developing sustained behaviour change (Verplanken and Orbell 2019). When a particular behaviour is frequent and consistently performed in the same context, it becomes habitual. For example, when a person regularly eats vegetables for lunch, eventually, that will become a habit. It happens because the association of action and the frequent occurrence of context guide future behaviour (van der Weiden et al. 2020). Thus, by cycling around the home in the afternoon or walking home from work/school, one adopts such healthy behaviours and seeks them because of habit. Once a new habit forms, it is somewhat effortless to perform that desired behaviour (Gardner and Rebar 2019). Evidence suggests that most young adults in low- and lower-middle-income countries fail to meet current PA guidelines (Hallal et al. 2012). Researchers viewed records from 2001 to 2016, conducted across 168 countries, and reported that the highest levels of PA were in high-income Western countries, Latin America and the Caribbeans, whereas the lowest levels were in Southeast Asia and Sub-Saharan Africa (Guthold et al. 2018). Studies also witnessed increased sedentary behaviours (such as screen time and extended sitting, like school or a car) among adolescents and young adults in Sub-Saharan Africa and Eastern Mediterranean regions (Khan et al. 2021; Wachira 2021). College years influence habitual physical activity for young adults throughout their adult life and, consequently, have significant implications for short- and long-term health outcomes. During the transition to university, exercise and fitness levels usually fade and are unlikely to improve with older age. Therefore, it is essential to promote habit strength as enduring behaviour change interventions at a young age in developing countries. To our knowledge, this is the first study investigating habit strength and how habit formation influences regulating physical activity in low- and lower-middle-income countries.

The present study aimed to ascertain (a) the associations of PA behaviours with PA habits and (b) the association between autonomous motivation and PA habits among university students. Our study hypothesised that – H1. (a) The PA-SRHI items will be intercorrelated, and (b) All components of PA behaviours (moderate-intensity, vigorous-intensity, strength training exercise) would be positively associated with PA habits; H2. (a) Autonomous motivation would be significantly associated with PA habits; (b) Autonomous motivation would be directly associated with all components of PA behaviours (moderate-intensity, vigorous-intensity, strength training exercise).

Methods

Participants and procedures

This cross-sectional study was carried out at North South University, Dhaka city, Bangladesh. Data was collected from August 16 to September 25, 2021. Participants were undergraduate students from the School of Business & Economics and the School of Engineering & Physical Sciences. To be included in this study, participants had to be 18–25 years old; and no further exclusion criteria were laid forth. The selection criterion was each school size ($n > 500$) to ensure that sufficient data could be collected. Based on this principle, five sections from each school were selected using a simple random sampling. Each section provided around 30–35 students. Afterwards, researchers contacted the department chair to obtain agreement. The study sample size was determined by using 80% power and 95% CI (0.05 to 1.96). A previous survey indicated that 18.5% of the population met the recommendations for physical activity (Prince et al. 2020). The required sample size estimation was 231. The campus was closed, and classes were resumed online, per government regulations; therefore, a department staff member provided each student's school email address for data collection purposes. At first, an invitation was sent with an informed consent paper providing information explaining the purpose of the study and assurance of confidentiality of the questionnaire, where participants were asked whether they would agree to take part in this study and if so, they were provided with an online questionnaire to their school email address. The questionnaire was sent to a total of 300 participants, and we received informed consent from 245 students interested in participating in this study, and 226 completed the online questionnaire with a response rate of 75.3%. Lastly, these 226 participants were added to the final analysis.

Data was collected using a structured questionnaire where the baseline sociodemographic variables concerned with this study were age, gender, area of residence, university year and BMI. Age was measured as a continuous variable. Gender was a categorical variable assessed as male, female and others. The area of residence was included by asking participants if they lived in the home, campus residence halls or other off-campus housing. The university year was recorded with four items first, second, third and fourth year. Two questions measured self-reported height and weight, respectively. These items were used to estimate Body Mass Index (BMI) category based on the formula BMI= weight in kg/ (height in cm)^2. BMI percentiles for age were recoded into categories as defined by CDC as follows, underweight (below 18.5), normal/healthy weight

(18.5–24.9), overweight (25.0–29.9) and obese (30.0 and above). The weight perception questionnaire was adopted from a nationwide population-based survey investigating body weight perception and weight control behaviours among Korean women (Park et al. 2019). Our study measured three items regarding this, where responses were self-reported. The first question asked to describe the participant's weight, and the response categories were 'very underweight,' 'slightly underweight,' 'about the right weight,' 'slightly overweight,' and 'very overweight.' The second item measured whether they were trying to control their weight or maintaining the same weight in the past 12 months. Students transition from college to university to adapt to a new academic and social environment related to weight gain (Yan and Harrington 2020). The third item examined self-reported weight gain by comparing current weight and weight during their past year of university and asking participants to select 'Yes' or 'No' as their response. Participants were also asked about their current physical activity status and categorised as 'Physically inactive/Physically active.' An additional question addressing students' exercise reduction between college and university was posed and was categorised as 'Yes/No' due to young adults' propensity to cease exercising frequently or change their habits after enrolling in the university.

A pilot study was conducted to check the research feasibility, where the questionnaire was given to 32 people anonymously in a separate sample. Afterwards, the questionnaire was modified accordingly, like words with three or more syllables were replaced for words with two or fewer syllables. For example, moderate-intensity was substituted with medium-strength, vigorous-intensity with high-strength, and strength training exercises with a strength workout. The estimated reliability of each scale was checked by Cronbach's alpha (value 0.964), showing excellent reliability.

Measures

Total PA

Three items were measured in the past seven days: moderate-intensity physical activity, vigorous-intensity physical activity and strength training exercises such as resistance weight machines for 8 to 12 repeats. The measurement scales for these items will range from 0 days to 5 days or more. These items were derived from American College of Sports Medicine (ACSM) guidelines. Current guidelines encourage promoting and maintaining health. All healthy adults need at least 150 min of moderate-intensity physical activity (MPA) per week, which can be 30 min of moderate-intensity aerobic activity for at least five days a week. Alternatively, 60 min of vigorous-intensity physical activity (VPA) per week, which can be 20 min of vigorous-intensity physical activity on at least three days per week, and 8–10 strength training exercises with 8–12 repetitions of each exercise twice a week (Fiatarone Singh et al. 2019). A combination of moderate-intensity and vigorous-intensity physical activity can meet the guidelines. In this study, the total number of participants meeting the ACSMs' guidelines for physical activity was computed by adding individuals who met the guidelines by their levels of MPA alone, VPA alone or a combination of both.

PA habits

The self-reported habit index assessed the general PA habit strength (Verplanken and Orbell 2019) where the items begin with the proposition: 'In general, the decision to engage in PA is something that…' followed by 12 items with 7-point Likert response options that range from entirely in disagreement to entirely in agreement 1 (strongly disagree) to 7 (strongly agree). A sample item is '…I do frequently'. Based on the stems of the 7-point Likert scale, the categories are weak (with a score <3), moderate (a score of ≥ 3 and <6), or strong (with a score of ≥ 6) PA habits. Each item showed an excellent internal consistency (Cronbach alpha score 0.957, Table 3).

Autonomous motivation

Autonomous motivation toward PA was assessed using a four-item scale (Brunet et al. 2015). Where the items begin with the proposition: 'I try, or would like to try, to be physically active regularly because…' followed by two-item intrinsic (e.g., 'Because of the pleasure I feel during PA') and two-item identified (e.g., 'Because I believe it is really important to be physically active') sub-scales. Answers were given on a Likert scale ranging from 1 (Not at all for this reason) to 7 (Totally for this reason). Each item showed an excellent internal consistency (Cronbach alpha score 0.924, Table 3).

Statistical analyses

Data were analysed using Statistical Package for the Social Sciences (SPSS) software version 25.0. The z-score transformation was performed for each outcome variable to check outliers. Cases with $|z| \geq 3.29$ typically indicate potential outliers. By using these criteria, no significant outliers were identified in our data. Descriptive statistics were denoted as means and standard deviations (SD) for continuous variables and number (n) and percentages (%) for categorical variables. Pearson's Chi-square test was applied to see the associations of physical activity levels with participants'

characteristics. A binary logistic regression model was used to distinguish the significant predictors in meeting physical activity guidelines and presented as adjusted odds ratios (AOR) with a corresponding 95% confidence interval. We also obtained logistic regression models' tolerance and variance inflation factors (VIF) to evaluate potential multicollinearity. We observed the reliability and internal consistency of SRHI and autonomous motivation components by Cronbach alpha and intra-class correlations coefficient (ICC). Additionally, Pearson (r) correlational coefficients were stated as concurrent validity evidence. From the theoretical perspective, it is expected that PA-SRHI items will be correlated.

Based on previous studies, path analysis was employed to examine the association between PA habits with PA behaviours and autonomous motivation, including all hypothetical pathways, using SPSS AMOS version 24.0 (Judah et al. 2018; Zhang et al. 2020). Multiple indices were estimated to consider the goodness of the fitted model: the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardised root mean squared residual (SRMR). An acceptable model fit criteria is indicated by RMSEA < 0.05, SRMR <0.08, and TLI, and CFI > 0.90 (Xia and Yang 2019). The association between PA habits with PA behaviours and autonomous motivation was reported as standardised beta coefficients (beta) with a 95% confidence interval (95% CI). All tests were considered significant at a p-value < 0.05.

Results

Of 226 participants, 53.1% were male, and half of them belonged to the age group 21–23 years (54.4%), with a mean (SD) age of 21.51 (1.80). The majority resided in their home (78.8%), and 14.6% lived in other off-campus housing. Most of the participants (34.5%) were in their 2nd year. Under the category of BMI, the majority (64.2%) were classified as healthy/average weight, whereas 21.2% were overweight. Concerning weight perception, 31.4% perceived their weight was about the right weight; 38.9% of participants reported they were doing nothing about their weight; 46.9% reported gaining weight between college and university, and 55.8% mentioned they were physically active; half (58.4%) had reduced exercise levels between college and university. (Table 1)

PA levels were assessed using the American College of Sports Medicine (ACSM) guidelines for adults, where participants were classified based on whether they met ACSM's physical activity guidelines of 30 min of MPA on five or more days, 20 min of VPA on three or more days or a combination of both (Haskell et al. 2007). For example, those who performed 30 min of MPA on two days and 20 min of VPA on three days were classified as meeting the guidelines. In our study, 37.6% of participants met these ACSM guidelines. Only one-fifth of participants met the recommended levels of MPA (19.0%) and VPA (17.3%). The current recommendation for strength training exercises is 8–12 repetitions of each exercise twice a week (Haskell et al. 2007), where only 2.7% of participants met this recommendation. Binary logistic regression identified age groups and gender as significant predictors in meeting physical activity guidelines. Therefore, students aged below 20 years old were 2.94 times more likely to meet the physical activity guidelines (OR = 2.94, CI = [1.29–6.71], p-value < 0.01). Similarly, male students were 2.22 times more likely to meet the physical activity guidelines (OR = 2.22, CI = [1.27–3.88], p-value < 0.01) than female students. Furthermore, a significant proportion of participants who were trying to lose weight were 1.58 times more likely to meet physical activity guidelines (OR = 1.58, CI = [0.58–4.32], p-value < 0.05) than others. Other variables were not found to be significant. (Table 2)

Participants engaged in moderate to vigorous-intensity and strength training physical activity reported moderate PA habits [Mean (SD)= 4.02 (1.58)] and a moderate autonomous motivation towards PA [Mean (SD)= 5.51 (1.34)] (Table 3).

The concurrent validity for all the items of SRHI had significant correlations (p-value < 0.01). Moreover, the normality of each item was checked in terms of its skewness (–0.38 to 0.23) and kurtosis (−0.92 to –1.28). The acceptable values of skewness fall (between −3 and +3), and kurtosis is appropriate from a range of (−10 to +10) recommended for a CFA with maximum-likelihood estimation (Brown 2006) (Table 4).

In the path analysis, after including all the hypothetical pathways, the model demonstrated an inadequate fit to the data (CFI = 0.907; TLI = 0.813; RMSEA = 0.046; SRMR = 0.079). Vigorous-intensity physical activity were found not significant; thereby after removing them, the model presented an adequate fit to all data (CFI = 0.985; TLI = 0.970; RMSEA = 0.068; SRMR = 0.039) (Fig. 1). The model explained a total of 68% of the variance in PA habits. Moderate-intensity physical activity (β = 0.045, CI = [0.069–0.248], p < 0.01), and strength training exercises (β = 0.133, CI = [0.148–0.674], p < 0.01) were significantly associated with PA habits. Autonomous motivation was directly and significantly related to PA habits (β = 0.062, CI = [0.295–0.541], p < 0.01). Autonomous motivation was also significantly related to moderate-intensity physical activity (β = 0.243, CI = [0.078–0.266], p < 0.01), and strength training exercises (β = 0.202, CI = [0.033–0.594], p < 0.05).

Table 1 Participants Characteristics (n=226)

Characteristics	Frequency (n)	Percentage (%)
Age groups, (in years)		
Below 20	44	19.5
21–23	123	54.4
Above 24	59	26.1
Mean (SD)	21.51 (1.80)	
Gender		
Male	120	53.1
Female	105	46.5
Others	1	0.4
Area of residence		
Home	178	78.8
Campus residence hall	15	6.6
Other off-campus housing	33	14.6
University year		
1st year	64	28.3
2nd year	78	34.5
3rd year	42	18.6
4th year	42	18.6
BMI (kg/m^2)		
Underweight	11	4.9
Healthy	145	64.2
Overweight	48	21.2
Obese	22	9.7
Mean (SD)	23.76 (4.22)	
Weight perception		
Very underweight	12	5.3
Slightly underweight	29	12.8
About the right weight	71	31.4
Slightly overweight	69	30.5
Very overweight	45	19.9
Trying to do something about weight		
Doing nothing	88	38.9
Trying to stay the same	58	25.7
Trying to lose weight	59	26.1
Trying to gain weight	21	9.3
Weight gain between college and university		
No	120	53.1
Yes	106	46.9
Current physical activity status		
Physically inactive	100	44.2
Physically active	126	55.8
Exercise reduction between college and university		
No	94	41.6
Yes	132	58.4

Discussion

Habits account for a substantive dimension of people's daily actions. Everything that we do combines our behaviour which has developed from habits; therefore, creating healthy habits is indispensable to increasing the quality of life and promoting longevity. Understanding habits' pervasiveness will provide insight into the physical activity context that can become habitual and establish PA habits among young adults. This study examined the associations of PA

Table 2 Association of PA meeting guidelines with participants characteristics

	Met		Not met		*p*-value	OR
	n	(%)	n	(%)		(95%CI)
Age groups, (in years)						
Below 20	23	27.1	21	14.9	0.033	2.94 (1.29–6.71)**
21 – 23	46	54.1	77	54.6		1.57 (0.79–3.11)
Above 24	16	18.8	43	30.5		Reference
Gender						
Male	55	64.7	65	46.1	0.008	2.22 (1.27–3.88)**
Female	29	34.1	76	53.9		Reference
Area of residence						
Home	70	82.4	108	76.6	0.580	1.66 (0.72–3.79)
Campus Residence Hall	5	5.9	10	7.1		1.28 (0.34–4.79
Other off campus Housing	10	11.8	23	16.3		Reference
University year						
1st year	22	25.9	42	29.8	0.739	1.05 (0.46–0.39)
2nd year	31	36.5	47	33.3		1.32 (0.60–2.89)
3rd year	18	21.2	24	17.0		1.42 (0.58–3.46)
4th year	14	16.5	28	19.9		Reference
BMI (kg/m^2)						
Underweight	4	4.7	7	5.0	0.152	0.57 (0.13–2.53)
Healthy	47	55.3	98	69.5		0.47 (0.19–1.16)
Overweight	23	27.1	25	17.7		0.92 (0.34–2.53)
Obese	11	12.9	11	7.8		Reference
Weight perception						
Very underweight	2	2.4	10	7.1		0.27 (0.05–1.39)
Slightly underweight	10	11.9	19	13.5	0.534	0.72 (0.27–1.89)
About the right weight	28	33.3	42	29.8		0.91 (0.43–1.95)
Slightly overweight	25	29.8	44	31.2		0.78 (0.36–1.68
Very overweight	19	22.6	26	18.4		Reference
Trying to do something about weight						
Doing nothing	21	25.0	67	47.5		0.42 (0.16–1.13)
Trying to stay the same	22	26.2	35	24.8	0.002	0.84 (0.30–2.31)
Trying to lose weight	32	38.1	27	19.1		1.58 (0.58–4.32)*
Trying to gain weight	9	10.7	12	8.5		Reference
Weight gain between college and university						
No	39	45.9	81	57.4	0.091	0.63 (0.37–1.08)
Yes	46	54.1	60	42.6		Reference

OR = odds ratio; CI= confidence interval.

*$p < 0.05$, **$p < 0.01$

Table 3 The mean, SD and reliability of the SRHI of PA

Variables	Mean ± SD	Range	α	ICC
PA habits	4.02 ± 1.58	1–7	0.957	0.677
Intrinsic motivation	5.33 ± 1.42	1–7	0.981	
Identified motivation	5.68 ± 1.35	1–7	0.982	0.815
Autonomous motivation	5.51 ± 1.34	1–7	0.924	

SD, standard-deviation; SRHI, self-report habit index; PA, physical activity; ICC, intra-class correlations coefficient.

Cronbach's α coefficients showed excellent internal consistency reliability for the PA habits. ICC showed moderate reliability for the PA habits and good reliability for the Autonomous motivation scales

behaviours with PA habits. Moreover, it also sought the association of autonomous motivation with PA habits and PA behaviours among university students. The findings in our study showed that moderate-intensity and strength training exercises were significantly associated with PA habits. In addition, results also showed that autonomous motivation was directly associated with PA habits and significantly related to moderate-intensity and strength training exercises.

An increasing level of PA is associated with a broad spectrum of benefits, from advancements in lipid and glucose homeostasis to enhanced endothelial function; such health outcomes have habitually occurred independently of advances in BMI (Wyszyńska et al. 2020). A higher level

Table 4 Pearson correlations, means and standard deviations for PA SRHI items

Item	1	2	3	4	5	6	7	8	9	10	11	12
1	–											
2	0.904**	–										
3	0.806**	0.800**	–									
4	0.793**	0.764**	0.771**	–								
5	0.668**	0.692**	0.720**	0.748**	–							
6	0.647**	0.668**	0.691**	0.702**	0.868**	–						
7	0.642**	0.661**	0.680**	0.645**	0.825**	0.854**	–					
8	0.623**	0.631**	0.686**	0.668**	0.763**	0.797**	0.823**	–				
9	0.611**	0.596**	0.657**	0.679**	0.691**	0.731**	0.731**	0.784**	–			
10	0.683**	0.634**	0.574**	0.713**	0.517**	0.546**	0.474**	0.481**	0.502**	–		
11	0.566**	0.519**	0.506**	0.561**	0.487**	0.522**	0.521**	0.512**	0.602**	0.680**	–	
12	0.570**	0.580**	0.514**	0.571**	0.547**	0.536**	0.551**	0.523**	0.548**	0.639**	0.826**	–
Mean	4.48	4.41	3.86	4.20	3.76	3.76	3.80	3.65	3.62	4.58	4.19	4.18
SD	1.89	1.98	1.92	2.07	1.88	1.84	1.88	1.89	1.89	1.93	1.87	1.84

SRHI, self-report habit index; PA, physical activity

**Correlation is significant at the 0.01 level (2-tailed)

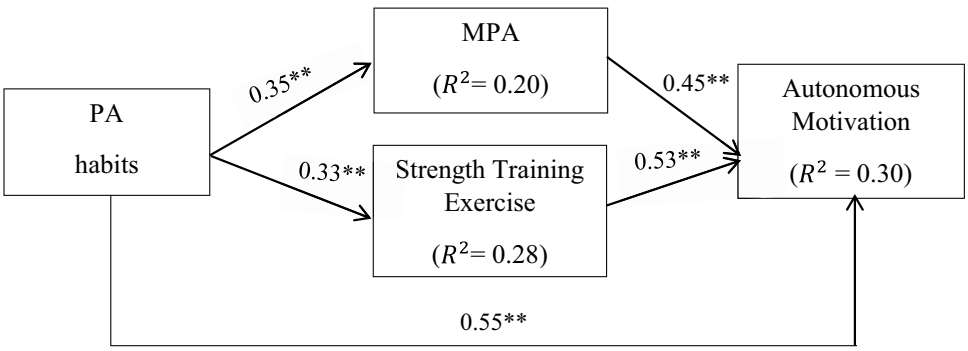

Fig. 1 Path diagrams illustrating the evidenced associations of PA behaviours and autonomous motivation for PA with PA habits. Note. Significant associations are represented with solid lines. Standardized beta coefficients (β) and R-squared (R^2) are reported. **$p < 0.001$

of PA from a young age can lessen chronic disease and enhance life expectancy in adulthood. The moderate-intensity PA provides substantial health benefits accompanying vigorous-intensity and strength training exercises. Research shows that significant weight gain occurs among college/university students. The American College Health Association National College Health Assessment (ACHA-NCHA, Spring-2021), a yearly national college survey, reported that 23.4% and 9.5% of college students were overweight and class I obese. Similarly, 21.2% of our participants were overweight, and 9.7% were obese. Another study on eating behaviour in Bangladesh, conducted among university students, found that 23.6% were overweight and obese (Al et al. 2021). Transitioning from high school to college/university is crucial for young adults. College freshers/1st-year university students commonly gain about 8 pounds of weight. The phrase 'the freshman 15' has been spawned because of that. A study found that one-quarter of participants had a 5 pounds weight gain during the first semester of college (Anderson et al. 2003). In another report from the University of Georgia, Athens, students gained 3 to 4 pounds, on average, during their first semester; 46.9% of our study participants self-reported their weight gain compared to their current weight. Regardless of weight status, students seemed to become active in many ways; as reported, 55.8% of our study participants were physically active. Studies showed that overall, the physical activity level among university students was considered satisfactory, although the percentage was slightly lower in female students (Fagaras et al. 2015; Rajappan et al. 2015). In recent years, college students have participated in fewer physical activities due to the typical inactive lifestyle (Ge et al. 2021). Transition to college, portrayed by changes in autonomy, time constraints and financial limitations, are the barriers. Particularly first-year students experience this adjustment for first time in their life (Buckworth and Nigg 2004). In this study, 58.4% of participants responded to decreased PA levels between college and university. From previous studies, only 40–45% of college students were engaged in PA regularly (≥3 days/week) (Leslie et al. 2001). Many students endure high stress-related

fatigue; this high prevalence negatively impacts their health and academic performance. In contrast, active people encountered PA as resilient (Wright et al. 2021). One study indicated that students tend to exercise to have positive feelings by keeping themselves healthy (Eichorn et al. 2018).

Moreover, our study results identified age groups and gender as significant predictors of meeting PA guidelines. A cohort study conducted among South Korean adults revealed age groups, sex, education and obesity as predictors of meeting PA guidelines (Kim 2017); similar results were found in a nationwide study conducted in Finland (Wennman and Borodulin 2020). In addition, a significant proportion of our participants trying to lose weight were 1.58 times more likely to meet PA guidelines. Understanding the connection between weight perception and weight control is essential for adolescents' health behaviours. From the 2007–2014 datasets obtained from the National Health and Nutrition Examination Survey (NHANES), a study revealed that males who perceived themselves as overweight or obese were 2.09 times more likely to be in the active group (Xu et al. 2018). A longitudinal study conducted among secondary school students in Ontario and Alberta, Canada, showed that weight perceptions of 'about the right weight' was most favourable for PA and dietary behaviours (Patte et al. 2016). Young adults with self-reported weight perceptions of being 'slightly overweight' and 'very overweight' were more likely to participate in PA (Mahat and Zha 2022). Research conducted among adolescents residing in Southern California examined the relationship of body weight perception with PA and dietary habits, where those who perceived themselves as fit and overweight were physically active and ate healthier foods (Gaylis et al. 2017).

Furthermore, the findings of our study showed that PA habits had a significant association with PA behaviours (moderate-intensity and strength training exercises). Previous research also showed that PA habits were correlated with PA behaviours (Gardner et al. 2011). Similarly, another study found an immediate and long-lasting impact on PA behaviours and habits (Joshi and Dodge 2022). Adopting health-promoting behaviours such as increasing PA is necessary for improving quality of life and physical and mental health. Behaviour requires performance or, in other words, repetitions to attain the desired health outcomes; it can be one performance, such as vaccination (Harper et al. 2004), or repeated performance, such as physical activity (Erikssen et al. 1998). Going for a run once will not reach the same health benefits as regular activity over a prolonged period. In such cases, changing behaviour requires a long-term process with capability, opportunity and motivation (Gardner and Rebar 2019). Habitual behaviours can be protective in any grade with conscious motivation; thereby, habit formation has brought particular attention as a possible mechanism for changing behaviour (Verplanken and Wood 2006). The habit construct is one of the most enduring in health psychology. Habits are cue-contingent, and via behavioural repetition in specific cue contexts, the habitual response progressively becomes the default; hence it is a powerful determinant of changing behaviour in daily life (Verplanken and Orbell 2019). While previous studies showed that stronger PA habits increase the possibility of regular involvement in PA, which is supported by the association between self-reported habits and exercise frequency, it also ensures that people will not seek unhealthily behaviour (Rebar et al. 2020). One study captured that habitual behaviour is more mentally accessible than non-habitual behaviours; thereby, they are quick and frequent in the presence of cues (Gardner 2015). Because of habits' cue-contingent nature, people may quickly adjust to their existing habits due to habitual action if discontinuity occurs (Maltagliati et al. 2021).

PA habits were directly associated with autonomous motivation in this study. Previous studies suggest that prior habitual action was more predictive of habit strength among more autonomously motivated participants (Gardner and Lally 2013). Self-determination plays a vital role in adopting and maintaining health-promoting behaviours among young adults (Daley and Duda 2006). Autonomous motivation facilitates behavioural automaticity, with high-level automaticity achieved for highly self-determined people, even with less frequent behaviours when behaviours were performed (Radel et al. 2017). Besides physical activity, autonomous motivation was also influential in tobacco abstinence, where self-determination theory intervention facilitated increased autonomous self-regulation and perceived competence and higher rates of long-term tobacco abstinence (Williams et al. 2009). These outcomes align that autonomous motivation can nurture the development of habitual behaviours.

Two psychological factors, motivation and self-efficacy and the perception of one's health are consistently linked to more powerful PA levels (Notthoff et al. 2017). The relationship between autonomous motivation and PA behaviours varies across settings. Our study found that autonomous motivation was significantly related to moderate-intensity and strength training exercises. The development of habitual routines at an early age could benefit future health outcomes. Parents may help motivate their children, which can significantly influence engagement in health-promoting behaviour, for example, PA. The findings from a recent study in Slovenia among primary school children and their parents showed that mothers' moderate-vigorous PA was significantly associated with children's moderate to vigorous-intensity PA (Zovko et al. 2021). Self-determination theory applied among US school adolescents showed that both identified regulation and intrinsic motivation were positively associated with moderate to vigorous-intensity PA (Nogg et al. 2021). Autonomous motivation is often related to enduring PA behaviour, and its regulated behaviour refers to the

choice and meaningfulness of behaviour without external pressure (Willem et al. 2017). These results support that autonomous motivation and avoiding excessive external rewards can positively impact changing behaviour.

Strengths and limitations

Findings from the present study should be evaluated with consideration of some limitations. First, our research was cross-sectional, making it difficult to ascertain the causality of the perceived associations. Although our analytical model was based on an endorsed theoretical framework, the possibility of reversed causations cannot be ruled out. Second, we did not measure the past behaviour frequency of the participants. Therefore, the role of habit and intention in predicting future behaviour could not be possible in this study. Finally, we did not extend the prediction of automaticity or any positive relationship between behaviour frequency and automaticity. We might employ these particular points in a longitudinal design for future research. The structure of our sample size setting has shown satisfactory results in SRHI-12 items validity. We measured both the validity and reliability of each component where SRHI-12 items showed excellent reliability, and additionally, all items were intercorrelated. Concerning SRHI items and their validity, there has been criticism of its subscales; the validity of whether self-reports on action may advance outside of self-awareness has been questioned. Research suggests that it is not necessarily vital that more vigorous habits reflect superior predictive validity of the SRHI, as the action can be solely attributed to automaticity. Nonetheless, the SRHI-12 items had come to be accepted as an adequate measure of habit based on our data analyses.

Conclusion

The study findings indicate that PA habits evolved in participants who perceived physical activity as their daily behaviour. Formation of habits requires instrumental learning guides attention to context cues. Hence, the stimuli that have been rewarded in the past acquire attentional priority over non-rewarded ones effortlessly. These findings have shown implications for the efficiency of using habits to examine PA behaviour in young adults and are appropriate for diverse populations and settings. The hypotheses also suggest autonomous motivation may function uniquely due to differences in psychological need satisfaction during this developmental period. Therefore, promoting engagement in a physical activity needs prior attention across any context.

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Authors' contributions All authors wrote, read and approved the study for publication in JOPH.

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Data availability For literature review all selected articles are availabel in open system. The data underlying the results presented in this study will be provided on reasonable request to Dr. Mohammad Delwer Hossain Hawlader. Email: mohammad.hawlader@northsouth.edu

Code availability N/A

Declarations

Ethical approval Ethical approval of this study was obtained from the Institutional Review Board (IRB)/Ethical Review Committee (ERC) of North South University (2021/OR-NSU/IRB/0402). Approval to conduct the study was taken from the department chair of each school. Participants were informed that their participation was voluntary and refusal to participate would not result in a penalty. We assured them that all of the details acquired would be anonymous and only be utilised for research purposes. The participants provided their consent; no incentive was given to anyone. All data were collected anonymously and would not identify the participants; confidentiality was assured.

Consent to participate Not required in a literature review.

Consent for publication N/A

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