Essay: Physical exercise as an independent factor influencing intrinsic academic motivation: A cross-sectional study of preclinical year medical students at Chulalongkorn University

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Running title: Intrinsic motivation to study at medical school and its correlates: A cross-sectional survey of preclinical students at Chulalongkorn University, Thailand

Background: Motivated students usually go on to achieve academic success. However, despite being of great interest to the Asian medical academia the factors potentially stimulating students’ intrinsic academic motivation have yet to be fully explored. The existing literature has not yet reported how lifestyle behaviors may influence the motivation of students to study. This study, therefore, aimed to assess the association
between lifestyle behaviors (such as exercise, sleeping time, sitting time, screen time, and vegetable intake), and preclinical year students’ intrinsic academic motivation.

Methodology: A total of 298 preclinical year students, about to start their second year of the medical school curriculum at the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand participated in this cross-sectional study with informed consent. Academic motivation was measured by applying a transculturally-translated Academic Motivation Scale (AMS).

Lifestyle information of the students was prospectively collected using structured questionnaires and anthropometric measurement. Physical exercise time was investigated by asking the frequency of exercise per week and the duration of exercise per time. STATA SE version 11 was used to run robust regression analysis, treating the intrinsic motivation score as the dependent variable in a multivariable model.

Result. The level of intrinsic motivation was positively influenced by the student’s physical exercise time per week after adjusting several relevant covariates (beta 0.85, 95%CI 0.44-1.28, P<0.001). This represents a novel correlation.

Discussion

Encouraging students’ engagement in physical exercise may result in an increase in their intrinsic drive to study. Physical exercise can represent a form of evidence-based, extracurricular motivation intervention.

Key word: intrinsic motivation, exercise, behavior, medical education

TEXT (3188 words)

Introduction

Motivation is a state of energetic movement towards goals. Medical students usually have a high level of motivation for study(1), although such motivation differs among individuals both in amount and type. Depending on whether motivation is reward-based extrinsic motivation or independent intrinsic motivation, will impact upon a student’s adaption to academic challenges, and consequently upon the quality of their life (2-4). A higher level of intrinsic motivation results in an inherent drive for social and cognitive development, whereas overwhelming extrinsic motivation can lead to stress, anxiety and burnouts upon encountering difficulties, challenges and setbacks (3, 5). Recently, Asian medical students have been reported to be more extrinsically motivated, and likely, therefore, to face the aforementioned psychosocial problems(3). Intrinsic motivation is the desired type of motivation that drives medical students’ learning quest and satisfaction. Hence, the factors influencing intrinsic motivation have become a particular research interest in medical education(2).

Within the existing literature little research has studied motivation as the dependent variable(6). Most previous studies have explored psychosocial factors within the context of the classroom environment. Recently, Kusurkar et al. reported that autonomy, competency and relatedness of the educational environment represented basic psychological factors determining intrinsic motivation(6). However, whether intrinsic motivation for academic performance is influenced by students’ lifestyle behaviors has not yet been investigated. (7)

Sleep, an essential requirement for human health, may influence academic performance, mental health and wellbeing (7, 8). Prolonged sitting similarly may have a significant impact. Medical students sit for long periods in class and tutorials, yet recent evidence has revealed the undesired effect of prolonged sitting on physical and mental health (9, 10). A further lifestyle choice, the consumption of vegetables, is encouraged as a healthy behavior in the prevention of many diseases(11). It has been shown to protect human cognitive function and might therefore have an impact on students’ intrinsic motivation to study. Studies linking such daily lifestyle behaviors of students to their intrinsic motivation to study are still necessary. Exercise has been reported to improve the academic performance, cognitive function and long term memory of adolescents(12). It is also recognized as a mood enhancer to treat depression(13). Whether physical exercise influences intrinsic motivation, though, has not yet been reported in the existing literature.

Lifestyle can be modified or developed by making informed choices. Exploring the link between lifestyle behaviors and medical education may identify modifiable factors influencing intrinsic academic motivation. Therefore, this study attempted to fill a gap in the literature by exploring the lifestyle behavioral factors influencing the intrinsic motivation of medical students.

We aimed (1) to determine the type of academic motivation- extrinsic or intrinsic- possessed by preclinical medical students (2) to determine the association of various lifestyle behaviors-exercise time, sitting time,
sleep time, screen time, vegetable intake and anthropometry- to the intrinsic motivation of medical students to study. The findings of this study may provide clues as to how to devise interventions to promote education, health and wellbeing of medical students through their intrinsic academic motivation.

Methodology
Study setting, design and ethics
The study was conducted at the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. It is the top-ranking and second oldest medical school in Thailand, representing one of the leading academic institutions in Asia. Its medical curriculum is a 6 year long, outcome-based curriculum striving to cultivate both the personal and professional development of its medical students. The first year curriculum includes several components in personal development, general science and social science. In the next two preclinical years, students are exposed to basic medical science subjects, and in the remaining three years students study the clinical subjects.

The current study was a cross-sectional study comprising a total of 296 preclinical medical students who had just completed the first year course work and were about to enter their second year. This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University (Approval number: Med Chula IRB 643/2557).

Measurement
Motivation
The students’ academic motivation was measured using the Academic Motivation Scale (AMS), a 28 item, 7 point Likert scale (14). The AMS is an internationally validated, temporally stable psychometric instrument, most relevant in medical education to measure students’ motivation (2, 15). The AMS was transculturally adopted to the Thai context, following WHO recommended steps: (1) forward translation, (2) back translation, (3) comprehension and readability test and (4) final version (16, 17). A pilot test preceded the actual study. The reliability coefficient using Cronbach’s alpha, was 0.866.

Lifestyle behaviors
Students’ lifestyle behavior, such as exercise time, sleeping time, sitting time, screen time and vegetable intake were investigated through self-administered, structured questionnaires. The frequency of exercise per week, the duration of exercise per episode and the type of preferred exercise were asked in order to calculate the exercise time of a student per week. This was an adaptation of the Behavioral Risk Factor Surveillance (BRFSS) questionnaire of the United States Center for Disease Control (CDC-US) (18). Vegetable intake was investigated also using the adapted CDC-US BRFSS questionnaire (18). Data collectors were trained how to administer the questionnaires effectively. This included providing the participants with a thorough briefing of how to fill the questionnaires in, notably in terms of not discussing with each other whilst doing so. The questionnaires took approximately 30 minutes to complete.

Biometric measurement
Anthropometric measures such as body weight and height, waist and hip circumference, and BMI of the students were measured. Biometric measurements were carried out prior to the study by faculty staff trained for such measurement. Lufkin?? standard measuring tape was used to measure waist and hip circumference.

Data management
The Academic Motivation Scale (AMS) comprises seven subscales based on self-determination theory (SDT): (1) intrinsic motivation to know (2) intrinsic motivation towards accomplishment (3) intrinsic motivation to experience stimulation (4) extrinsic motivation ‘identified regulation (5) extrinsic motivation-introjected regulation (6) extrinsic motivation external regulation and (7) amotivation (14). Each subscale has four items. An average of each subscale was taken as the sub-score. (Figure 1) The sum of subscales (1) to (3) constituted the dependent variable ‘intrinsic motivation’. Physical exercise time was computed from ‘the frequency of exercise per week’ and ‘the usual duration per time of exercise’. Vegetable intake was computed from ‘the number of days eating vegetables per week’ and ‘the serving of vegetables per day’. Each time a vegetable was eaten was counted as one time, according to BRFSS (19). Sleeping time, sitting time, and screen time on weekdays were used for analysis in a regression model. Data entry followed double entry and validation.

Data analysis
Intrinsic academic motivation was analyzed as the dependent variable in a multivariable regression model. Exercise time per week, sleep time per day, sitting time per day, screen time per day, gender, BMI and waist
hip ratio were first tested in a univariate analysis. The final model of robust regression was decided by either the statistical significance in the univariate analysis or relevancy. STATA version 11 SE was applied. Statistical significance was decided by a P value less than 0.05 and a 95% confidence interval (95% CI).

Results
A total of 296 second year medical students responded to the survey, with a response rate of 98%. Table 1 shows the characteristics of the participants. Almost half (43.92 %) of the students have a doctor in their family.

Table 1 Demographic characteristics of the respondents (N=296)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median, iqr)</td>
<td>19(0.57)</td>
<td>100.00%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>162</td>
<td>54.73%</td>
</tr>
<tr>
<td>Female</td>
<td>134</td>
<td>45.27%</td>
</tr>
<tr>
<td>Having a doctor in the family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>126</td>
<td>43.92%</td>
</tr>
<tr>
<td>No</td>
<td>166</td>
<td>56.08%</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>1.35%</td>
</tr>
<tr>
<td>Province of origin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangkok</td>
<td>165</td>
<td>55.74%</td>
</tr>
<tr>
<td>Outside Bangkok</td>
<td>131</td>
<td>44.26%</td>
</tr>
<tr>
<td>Graduated high school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>14</td>
<td>4.7%</td>
</tr>
<tr>
<td>Public school</td>
<td>271</td>
<td>91.6%</td>
</tr>
<tr>
<td>Missing</td>
<td>11</td>
<td>3.7%</td>
</tr>
</tbody>
</table>

Figure 1 shows the distribution of academic motivation according to the seven constructs of the AMS. The average level of intrinsic motivation in terms of the median and inter quartile range was 51 (44-59) out of 84; that of extrinsic motivation was 60 (54-66) out of 84. The intrinsic motivation level was less than the extrinsic motivation level (P<0.001, Sign rank test).

Figure 1 Academic motivation of pre-clinical medical students displaying extrinsic and intrinsic motivation constructs amongst males and females

Note: EM = extrinsic motivation, IM = intrinsic motivation

Lifestyle behaviors
The average sleeping time of students was 6 (6-7) (median and inter quartile range) hours a day, sitting time was 10 (8-10) hours a day and leisure screen time was 4 (2-5) hours a day. Students engaged in physical exercise for an average of 2.1 (1-4) hours a week. Very few students smoke (2.36%). More than one third of the students reported occasional social alcohol consumption. However, it was significantly more common among male students (53.3%) than female students (19.7%) (P=0.04) (Table 2). More than one tenth of the students usually drink energy drinks (eg. Redbull) prior to taking examinations. It was more common among male students (16.7%) compared to female students 8.2% (P=0.03). Anthropometric characteristics of the students are shown in table 3.

Table 2 Health behavior of preclinical medical students at Faculty of Medicine, Chulalongkorn University, Thailand 2014

<table>
<thead>
<tr>
<th>Health behavior</th>
<th>Median</th>
<th>IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical exercise (hours per week)</td>
<td>2.1</td>
<td>1-4</td>
</tr>
<tr>
<td>Sleeping time (hours per day)</td>
<td>6</td>
<td>6-7</td>
</tr>
<tr>
<td>Sitting time (hours per day)</td>
<td>8</td>
<td>8-10</td>
</tr>
<tr>
<td>Leisure screen time (hours per day)</td>
<td>4</td>
<td>2-5</td>
</tr>
<tr>
<td>Vegetable intake (serving per week)</td>
<td>10</td>
<td>5-14</td>
</tr>
<tr>
<td>Risk behaviors n %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco smoking</td>
<td>7</td>
<td>2.36</td>
</tr>
<tr>
<td>Occasional / social drinking consumption of alcohol</td>
<td>111</td>
<td>38.01</td>
</tr>
<tr>
<td>Energy drink before exam</td>
<td>38</td>
<td>12.84</td>
</tr>
</tbody>
</table>

Energy drink before exam 38 12.84
Iqr = interquartile range
Table 3 Anthropometry of the students
<table>
<thead>
<tr>
<th>Parameter</th>
<th>male</th>
<th>female</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>med</td>
<td>iqr</td>
<td>med</td>
<td>iqr</td>
</tr>
<tr>
<td>BMI (kg.m2)</td>
<td>21.7</td>
<td>20.4-23.7</td>
<td>20.1</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>76 72-81</td>
<td>68.75 64-74.5</td>
<td>73 67-73</td>
</tr>
<tr>
<td>Waist hip ratio</td>
<td>0.84</td>
<td>0.80-0.86</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Note: Med = median, iqr = interquartile range

Uni and multi variable regression analyses revealed a significant association between the time engaged in physical exercise per week and the level of intrinsic motivation to study (Table 4). An increase in exercise time of one hour per week promoted intrinsic motivation to study by a coefficient of 0.85 (beta 0.85 95% CI 0.44-1.26, P value <0.001). The final model of robust regression included measures of sitting time, sleep time, exercise time, screen time, vegetable intake, BMI, and waist hip ratio to predict the level of intrinsic motivation. Gender, alcohol consumption, tobacco use, and energy drink consumption were not significant according to univariate analysis, and were therefore not included in the final model.

Table 4 A model of robust regression determining the association between lifestyle-related behavior and medical students’ intrinsic motivation to study

Uni-variate regression Multi-variate regression
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Beta (95%CI)</th>
<th>P</th>
<th>beta (95%CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise time</td>
<td>0.69 (0.30-1.08)</td>
<td>0.001</td>
<td>0.85 (0.44-1.26)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sleep time</td>
<td>-0.25 (-1.84-1.35)</td>
<td>0.76 0.35 (-1.31-2.00)</td>
<td>0.677</td>
<td></td>
</tr>
<tr>
<td>Sitting time</td>
<td>0.24 (-0.33-0.82)</td>
<td>0.40 0.48 (-0.09-1.06)</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Screen time</td>
<td>-0.31 (-0.97-0.34)</td>
<td>0.34 -0.43 (-1.10-0.22)</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Vegetable intake</td>
<td>0.01 (-0.21-0.23)</td>
<td>0.93 0.59 (-0.17-0.28)</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>0.19(-0.27-0.63)</td>
<td>0.80 0.21(-0.31-0.74)</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Waist-hip ratio</td>
<td>2.4(-20.95-25.77)</td>
<td>0.84 -11.74 (-38.44-14-96)</td>
<td>0.39</td>
<td></td>
</tr>
</tbody>
</table>

BMI = body mass index, CI = confidence interval P = P value

Figure 2 Graphical regression analysis predicting intrinsic academic motivation by exercise time per week

Discussion

Most of the medical students are highly motivated learners(2). Their academic outcomes and strategy uses differ according to their orientation of academic motivation(7). A recent study reported that reward-based, extrinsically-oriented motivation was common among Asian medical students studying abroad. The current study measured intrinsic and extrinsic motivation levels of preclinical medical students’ studying at Chulalongkorn University, Thailand, an Asian setting, using the internationally-validated Academic Motivation Scale (AMS).

The levels of motivation in extrinsic constructs were higher than those in intrinsic constructs (Figure 1), hence, the finding was concurrent with that of previous studies in Asia (1, 3). Since the cross-sectional measurement was conducted before the new students became exposed to the actual medical curriculum, this finding would be particular to preclinical medical students. Students’ motivation may evolve towards more independent intrinsic motivation after exposure to the curriculum in the preclinical years and, after contact with patients and the community in later clinical years, although a review of medical education literature indicates that most curriculum designs overlook the affective domain of ‘motivation’(15).

Previous research focused on classroom and curricular factors as influencing medical students’ academic motivation (6). However, factors beyond the classroom environment realistically influence students’ motivation. A recent study by Flueckiger, L., et al questioned whether students’ academic outcomes are influenced by their lifestyle behaviors. Physical exercise and sleep were found to influence daily academic goal achievement outcomes through changes in students’ ‘affect’ (20).

The affective domain in education is a complex, personal domain. Likewise, lifestyle behaviors are unique to each student, although particular trends of behaviors among youth do exist. Importantly, lifestyle behaviors are modifiable via properly informed choices. Therefore, the current study analyzed the association of medical students’ modifiable lifestyles behaviors, such as sleep, sitting time, exercise time, screen time, vegetable intake as well as, ‘trendy’ behaviors such as smoking, drinking, and the use of energy drinks, with their
intrinsic motivation to study. The final model included sleep, sitting time, exercise time, vegetable intake, and anthropometry. Aside from exercise time, the other lifestyle behaviors investigated in this study, as well as BMI and waist circumference did not reveal any significant association. Since motivation, the dependent variable, is a context-sensitive psychometric outcome, future research in other settings may be able to make additional findings. The result of multivariate analysis showed that the duration in hours of exercise taken per week was the sole independent factor influencing intrinsic motivation (P<0.001, Table 4, Figure 2). An increase in the duration of exercise boosted the level of intrinsic motivation via a constant of 0.85. This may, therefore, represent a useful finding for medical schools and universities to apply as a way to increase the intrinsic academic motivation of their students in the future.

Evidence from concurrent findings
Studies have shown the benefits of physical exercise on academic achievement, mental health and cognition, mostly in study populations of adolescents and young school children (12). The impact of exercise has been shown to be beneficial in relation to several health outcomes (13, 21, 22). Recent research has reported that exercise can improve mental health, being recognized as a major stress reliever and a form of treating depression (21). The cellular physiological mechanism of antidepressant effects, brought about by exercise, was explained by Sanchis-Gomar et al (13).

Furthermore, recent research in education psychology has revealed the influence that exercise behavior exerts on the affective domain. Stanford researchers Oppezzo and Schwartz (2014) reported the positive effect that walking had on the generation of creative thoughts in a within-subject experimental study (23). They found that a walk of short duration before sitting down to work could increase the production of creative ideas (23). Furthermore, Flueckiger, L., et al recently reported on the positive influence that physical exercise has to the achievement of daily academic goals (20). Moreover, recent basic science research has indicated the influence that physical exercise has on human cognitive and social development. Neurological molecular scientists have reported that the brain mechanism Hippocampal neurogenesis (24), along with various chemical mediators is the explanation for how exercise can relieve depression (25). This concurrent evidence from different areas of medical research serves to support our finding that exercise, a lifestyle behavior, positively influences ‘intrinsic motivation’ within the affective domain of educational psychology. Moreover, the AMS, used to measure academic motivation, is based on self-determination theory (SDT) (5, 14). SDT can be applied not only within education but also in sports and exercise, health and well-being (26). According to SDT, ‘conditions supporting the individual’s experience of autonomy, competence, and relatedness can foster the most volitional and high quality forms of motivation and engagement for activities, including enhanced performance, persistence, and creativity.’ (26). Therefore, generating conditions in which students may be able to engage with these emotional constructs by engaging in physical exercise may in turn contribute to fostering their motivation for academic work.

To our knowledge, this study is the first of its kind reporting an association between exercise behavior and intrinsic motivation to study. The findings of this classroom-based study can provide unique insights relevant to a wider scope of educational research and intervention beyond the limits of the classroom context. Despite the limitations of this cross-sectional study design, the current study was strengthened by undertaking a careful measurement of variables, and applying a multivariable analysis within a robust regression model adjusting covariates. Moreover, the application of an internationally validated instrument may allow for the results to be compared to findings from other settings in the future.

Conclusion
To conclude, intrinsic motivation, the energy which leads medical students to achieve their success in a healthy and pleasant way, can be acquired by encouraging medical students to engage in physical exercise. Exercise, an extracurricular activity, can be an effective motivation intervention for learners, in addition to its physical and mental wellbeing benefits.

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