# EFFECTS OF BRAIN BREAKS ON PHYSICAL ACTIVITY, ACADEMIC SELF-EFFICACY, EMOTION REGULATION, SLEEP AND RESILIENCE AMONG CHINESE UNIVERSITY STUDENTS

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**by**

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| | |
|---|---|
| 5×5RS | Five-by-Five Resilience Scale |
| 5×5RS-C | Chinese version of the Five-by-Five Resilience Scale |
| ANOVA | Analysis of Variance |
| APAS | Attitudes towards Physical Activity Scale |
| ASES | Academic Self-Efficacy Scale |
| ASES-C | Chinese version of the Academic Self-Efficacy Scale |
| BLPAQ | Brunel Lifestyle Physical Activity Questionnaire |
| BLPAQ-C | Chinese version of the BLPAQ |
| Brain Breaks | Brain Breaks® Physical Activity Solutions |
| CFA | confirmatory factor analysis |
| CFI | Comparative Fit Index |
| CI | confidence interval |
| CR | composite reliability |
| ER | Emotion Regulation |
| ERQ | Emotion Regulation Questionnaire |
| ERQ-8-C | 8-item Chinese version of the Emotion Regulation Questionnaire |
| ERQ-C | Chinese version of the Emotion Regulation Questionnaire |
| ICC | intraclass correlation coefficient |
| JSS | Jenkins Sleep Scale |
| JSS-C | Chinese version of the Jenkins Sleep Scale |
| MI | modification indices |
| PA | physical activity |
| PPA | Planned Physical Activity |
| RMSEA | root mean square error of approximation |
| RPE | ratings of perceived exertion |
| SEM | Structural Equation Modelling |
| SRMR | standardized root mean square residual |
| TLI | Tucker and Lewis index |
| UPA | Unplanned Physical Activity |

## LIST OF APPENDICES

**KESAN PENGGUNAAN *BRAIN BREAKS* KE ATAS AKTIVITI FIZIKAL, EFIKASI KENDIRI AKADEMIK, PENGAWALAN EMOSI, TIDUR DAN KETAHANAN DIRI DALAM KALANGAN PELAJAR UNIVERSITI CINA**

## ABSTRAK

Menggalakkan aktiviti fizikal adalah penting untuk kesejahteraan pelajar universiti. *Brain Breaks*, sebuah program video dalam talian yang direka untuk bilik darjah, telah menunjukkan kesan positif terhadap pelajar sekolah rendah dan menengah, tetapi jarang digunakan di kalangan pelajar universiti. Kajian ini bertujuan untuk meneroka hubungan antara aktiviti fizikal, keberkesanan kendiri akademik, pengawalan emosi, tidur, dan ketahanan dalam kalangan pelajar universiti China dari Wilayah Jiangsu. Selain itu, kajian ini juga bertujuan untuk menilai kesan program aktiviti fizikal *Brain Breaks* terhadap pemboleh ubah-ubah ini di kalangan pelajar Universiti Vokasional Jiangsu di bandar Yancheng. Kajian ini terdiri daripada dua fasa: Fasa 1 (kajian keratan rentas) dan Fasa 2 (uji klinik rawak berkelompok). Dalam Fasa 1, 1534 peserta mengisi soal selidik. Data dibahagikan kepada dua kumpulan: 737 untuk analisis faktor pengesahan (CFA) dan 797 untuk pemodelan persamaan struktur (SEM). Fasa 2 melibatkan 103 pelajar universiti China dalam analisis variasi campuran (ANOVA). Versi bahasa Cina bagi soal selidik Brunel Lifestyle Physical Activity Questionnaire (BLPAQ-C), Academic Self-efficacy Scale (ASES-C), Emotion Regulation Questionnaire-8 (ERQ-8-C), Jenkins Sleep Scale (JSS-C), dan Five-by-Five Resilience Scale (5×5RS-C) digunakan untuk mengukur aktiviti fizikal, keberkesanan kendiri akademik, pengawalan emosi, tidur, dan ketahanan psikologi

dalam kalangan pelajar universiti. Lepas sahkan soal selidik dan hubungan antara pemboleh ubah, kami buat Fasa 2 untuk tengok kesan intervensi pada pemboleh ubah yang diukur. Peserta, ikut kelas, buat intervensi selama lapan minggu. Kumpulan eksperimen buat aktiviti fizikal *Brain Breaks* lima kali seminggu, lima hingga sepuluh minit setiap kali. Kedua-dua kumpulan isi soal selidik sebelum dan lepas intervensi. Kami analisis data yang dikumpul guna SPSS 26.0 untuk statistik deskriptif dan mixed ANOVA, dan Mplus 8.3 untuk CFA dan SEM. Dalam Fasa 1, kebanyakan peserta adalah perempuan (70.40%). Lepas buang item dengan muatan faktor rendah dan/atau tambah sisa berkorelasi dalam faktor sama, semua model tunjuk kesesuaian baik. Soal selidik versi Cina dah ditentukan, dan model struktur akhir sesuai dengan data soal selidik dengan baik. SEM hasilkan hubungan antara pemboleh ubah yang signifikan, dengan sembilan hipotesis khusus disokong oleh model akhir. Dalam Fasa 2, majoriti peserta juga terdiri daripada perempuan (71.84%). Terdapat kesan masa yang signifikan untuk aktiviti fizikal yang dirancang ($p < 0.001$) dan penindasan ($p = 0.020$). Kesan interaksi adalah signifikan dalam ASES-C ($p < 0.001$), Optimisme ($p = 0.001$), dan Sokongan Sosial ($p = 0.009$) dalam 5×5RS-C. Pemboleh ubah lain tidak diperhatikan sebagai signifikan secara statistik. Skor untuk ASES-C menunjukkan peningkatan yang signifikan dalam kumpulan eksperimen selepas intervensi. Kesimpulannya, kajian ini: 1) mengesahkan kebolehpercayaan dan kesahan soal selidik di atas di kalangan pelajar universiti China; 2) mendedahkan hubungan positif antara aktiviti fizikal dan keberkesanan kendiri akademik, pengawalan emosi, ketahanan, dan tidur; 3) mencadangkan bahawa intervensi *Brain Breaks* selama lapan minggu dapat meningkatkan secara signifikan keberkesanan kendiri akademik pelajar, menjadikannya sebagai strategi yang menjanjikan untuk digunakan dalam kalangan pelajar universiti.

# EFFECTS OF BRAIN BREAKS ON PHYSICAL ACTIVITY, ACADEMIC SELF-EFFICACY, EMOTION REGULATION, SLEEP, AND RESILIENCE AMONG CHINESE UNIVERSITY STUDENTS

## ABSTRACT

Encouraging physical activity is vital for university students' well-being. Brain Breaks, an online video program designed for classrooms, has shown positive effects on primary and secondary school students but is rarely used among university students. This study sought to explore the associations among physical activity, academic self-efficacy, emotion regulation, sleep, and resilience in Chinese university students from Jiangsu Province. It also aimed to assess the impact of the Brain Breaks physical activity program on these variables among students at Jiangsu Vocational University of Medicine in Yancheng city. The study consisted of two phases: Phase 1 (a cross-sectional study) and Phase 2 (a cluster-randomised trial). In Phase 1, 1534 participants completed questionnaires, which were translated using forward and backward method. The data were split randomly into two groups: 737 for confirmatory factor analysis (CFA) and 797 for structural equation modelling (SEM). Phase 2 involved 103 Chinese university students in the mixed analysis of variance (ANOVA). Chinese versions of the Brunel Lifestyle Physical Activity Questionnaire (BLPAQ-C), Academic Self-efficacy Scale (ASES-C), Emotion Regulation Questionnaire-8 (ERQ-8-C), Jenkins Sleep Scale (JSS-C), and Five-by-Five Resilience Scale (5×5RS-C) were used to measure physical activity, academic self-efficacy, emotion regulation, sleep and resilience among university students. After the validity and reliability of the questionnaires and the relationship between the variables were determined, Phase 2

was performed to explore the effects of the intervention on the measured variables. Participants, divided by classes, underwent an eight-week intervention, with the experimental group engaging in Brain Breaks physical activity five times a week for five to ten minutes per session. Both groups completed the questionnaire before and after the intervention. The collected data were analysed with SPSS 26.0 for descriptive statistics and mixed ANOVA, Mplus 8.3 for CFA and SEM. In phase 1, most participants were female (70.40%). After removing items with low factor loadings and/or adding correlated residuals within the same factor, all models exhibited good fit. The questionnaires of Chinese version were determined, and the final structural model fitted the data of the questionnaire well. The SEM produced a significant inter-relationship between the variables, with nine specific hypotheses supported by the final model. In Phase 2, the majority of participants also comprised females (71.84%). There was a significant time effect for planned physical activity ($p < 0.001$) and suppression ($p = 0.020$). The interaction effect was significant in the ASES-C ($p < 0.001$), Optimism ($p = 0.001$) and Social Support ($p = 0.009$) in the 5×5RS-C. Other variables were not observed to be statistically significant. The scores for ASES-C showed a significant increase in the experimental group after the intervention. In conclusion, the study: 1) confirmed the above questionnaires' reliability and validity among Chinese university students; 2) revealed a positive link between physical activity and academic self-efficacy, emotion regulation, resilience, and sleep; 3) suggested an eight-week Brain Breaks intervention could significantly boosts students' academic self-efficacy, positioning it as a promising strategy to use in university students.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Regular physical activity among adults (aged 18-64) that includes at least 150-300 minutes of moderate-intensity aerobic activity or at least 75-150 minutes of vigorous-intensity aerobic activity, or an equivalent combination of moderate and vigorous activity, can lead to significant health benefits (Bull et al., 2020). Engaging in structured sports and exercises can aid in weight management, promote cardiovascular health, improve psychological well-being and academic performance, as well as enhance personal responsibility and social participation among young individuals (Hills et al., 2015). Despite these advantages, population-based studies have reported that physical activity levels decline with age, from childhood to adolescence, and from adolescence to adulthood (Ortega et al., 2013). Physical activity levels among young people aged 10 to 19 years decline by an average of 7% per year, indicating a global decline of 60% to 70% by the time they reach adulthood (Dumith et al., 2011). In Chinese citizens aged 20 and above, only 14.7% are able to meet the recommended levels of physical activity (Wang, 2016). Research by Liu and Dai (2017) revealed that the average physical activity levels of Chinese university students are relatively low, with females being less active than males.

Prior to the outbreak of the COVID-19 pandemic, research indicated that 23.3% of adults worldwide did not meet the global recommendations for physical activity set by the World Health Organization (WHO, 2018). Additionally, sedentary behaviour was on the rise during that time (Du et al., 2019; Guthold et al., 2018). During the pandemic, the frequency of online courses increased in many countries and regions.

As a result, students spent more time sitting while attending these virtual classes, leading to an increase in sedentary behaviour and a reduction in overall physical activity levels. In China, the strict containment measures for the novel coronavirus gradually eased after the announcement in December 2022, and life began to return to pre-pandemic conditions. However, globally, during this unique period of the COVID-19 pandemic, the closure or shortened operating hours of sports facilities and other activity spaces contributed to a more significant decline in people's physical activity levels. University students experienced specific challenges during this time as their campuses adopted full or partial lockdown measures, restricting their daily lives and leisure activities, including access to sports facilities. The detrimental impact of insufficient physical activity on college students is evident; Pengpid et al. (2015) estimated that the prevalence of physical inactivity among university students in 23 low-income, middle-income, and high-income countries was approximately 41%. In contrast, engaging in appropriate physical activity has shown to prevent and manage non-communicable diseases such as cardiovascular diseases, cancer, and diabetes. Moreover, physical activity can help reduce symptoms of depression and anxiety and even enhance cognitive functions, learning, and decision-making abilities. Therefore, promoting a change in physical activity behaviour among adolescents, including university students, becomes crucial in such circumstances.

Schools are regarded as ideal settings to promote physical activities among students. Throughout a typical school week, students are presented with numerous opportunities for physical engagement, including recess, sports activities, and physical education classes. However, due to limited available time within these discrete periods and the reduction in physical activity opportunities during the current pandemic,

additional short-duration exercise plans may be necessary to achieve recommended activity levels. Leveraging fragmented time slots could be instrumental in this endeavour. One effective approach to break the sedentary behaviour and encourage physical activity among students is through the implementation of Brain Breaks. Specifically, the HOPSports Brain Breaks project offers an online physical activity video series designed for classroom environments, utilizing multimedia video technology. The project integrates fitness, enjoyment, learning, and recreation into physical activities, with the primary aim of promoting students' physical fitness and academic learning. These Brain Breaks activities provide not only opportunities for physical activity but also incorporate fun short videos that facilitate the acquisition of new motor skills, languages, music, and knowledge of diverse cultures. Consequently, children are motivated to participate in movement-based activities rather than merely engaging in sedentary video gaming. Each Brain Breaks video typically lasts between 2 to 5 minutes and covers various themes, such as art (dance and music), fitness skills (aerobic and functional exercises), sports (skills, cycling, rowing), educational topics (health, nutrition, and hygiene), and classroom activities (enjoyable fitness routines and dynamic sports) (Kuan et al., 2019; Zhou et al., 2021).

Research by Martin and Murtagh (2017) has demonstrated that classroom-based physical activity interventions can lead to improved physical activity levels, academic performance, and overall physical health among children. More recent studies have shown that the implementation of Brain Breaks in the classroom setting not only enhances students' attitudes toward physical activity but also boosts their motivation to engage in physical activities and internalize positive movement habits (Popeska et al., 2018; Zhou et al., 2021). Despite the simplicity and effectiveness of Brain Breaks, it is noteworthy that existing research on its implementation has

primarily focused on primary school children, with limited reports of interventions in other populations, such as university students. In the context of higher education, sedentary behaviour is prevalent among university students, particularly during lecture sessions, where students often remain seated and engrossed in their electronic devices, such as phones, tablets, and computers (Feiler, 2019). Consequently, there is an urgent need to extend physical activity interventions, such as Brain Breaks, to university classrooms and student groups.

## 1.2 Problem Statement

For university students, understanding the significance of physical activity, academic self-efficacy, emotional regulation, psychological resilience, and sleep is crucial for their overall well-being and academic achievements. Firstly, moderate physical activity contributes to maintaining physical health, enhancing cardiovascular function, controlling weight, and reducing the risk of chronic diseases. Moreover, physical activity provides energy, improves attention and memory, and fosters learning and cognitive abilities. Secondly, effective emotional regulation assists them in coping with academic pressure, interpersonal issues, and life challenges. Developing strong emotional regulation skills can alleviate anxiety, depression, and other negative emotions while promoting positive emotions, happiness, and life satisfaction. Next, psychological resilience is key to successfully meeting academic demands, adapting to life changes, and overcoming difficulties. Having higher levels of psychological resilience enhances confidence, perseverance, and the ability to cope with stress, helping students overcome setbacks and gradually achieve personal goals. Furthermore, academic self-efficacy is a crucial factor in achieving academic success. High levels of academic self-efficacy can stimulate learning motivation, increase effort

and focus, and improve academic performance and satisfaction. Lastly, adequate sleep promotes memory consolidation, enhances learning abilities, and boosts attention and creativity. Sleep deprivation, on the other hand, can lead to fatigue, lack of focus, emotional fluctuations, and learning difficulties. Therefore, physical activity, academic self-efficacy, emotional regulation, psychological resilience, and sleep are all vital for the physical and mental health, as well as academic development, of university students. By addressing and improving these aspects through practice and skill enhancement, university students can better cope with academic pressures, strengthen self-management abilities, and enhance their academic achievements and overall well-being.

In light of this, the question arises: How can we improve the aforementioned aspects among university students? A multitude of research studies have indicated direct or indirect links between physical activity and self-efficacy in learning, emotional regulation, psychological resilience, and sleep quality. Consequently, we systematically reviewed the relevant literature concerning physical activity among university students to gain insights into the current state of affairs.

The lack of physical activity is a global public health concern, particularly prevalent among college students. A substantial proportion of college students fail to meet the recommended weekly standard of at least 150 minutes of moderate-intensity physical activity. Additionally, they spend prolonged periods sitting during academic and work-related activities, leading to insufficient engagement in physical activity. Prolonged sedentary behaviour has been linked to various health issues such as obesity and cardiovascular diseases, as well as psychological problems like anxiety and depression.

Researchers are actively investigating strategies to reduce sedentary behaviour and increase physical activity levels among college students. These interventions encompass educational campaigns, physical activity programs, peer support systems, and environmental modifications. Moreover, some studies have integrated technological tools, such as mobile applications and wearable devices, into physical activity promotion efforts to enhance participation rates and effectiveness.

In intervention strategies, classroom-based physical activity holds unique advantages, such as its unrestricted nature, allowing utilisation of students' fragmented learning time, and flexibility for implementation at any time. The Brain Breaks project offers educators, researchers, and others a cost-effective and convenient multimedia web-based platform for incorporating classroom-based physical activities. Through this platform, researchers can conduct classroom-based physical activity programs. Implementing this project is both low-cost and time-flexible, making it an attractive choice for practical and scalable interventions. While previous research has shown positive impacts of the Brain Breaks physical activity intervention on the attitude towards physical activity among primary and secondary school students, its effects among university students remain underexplored, and its application in this context remains uncertain.

This study aimed to explore the impact of Brain Breaks on physical activity level, academic self-efficacy, emotion regulation, sleep, and psychological resilience among university students, with effective assessment tools being a prerequisite for evaluating intervention outcomes. Accordingly, the research was structured into two phases. One of the aims of the Phase 1 was to examine the reliability and validity of the Chinese versions of the Brunel Lifestyle Physical Activity Questionnaire, Academic Self-efficacy scale, The Emotion Regulation Questionnaire-8, Jenkins

Sleep Scale, and Five-by-Five Resilience Scale. Then, based on the validated questionnaire, a structural equation model was be employed to elucidate the interrelationships between physical activity, academic self-efficacy, emotion regulation, sleep, and psychological resilience among university students. Lastly, the study in Phase 2 employed an eight-week Brain Breaks physical activity intervention to observe changes in the aforementioned indicators, thereby investigating the feasibility of implementing this program among the Chinese university student population.

## 1.3 Rationale and Significance

For university students, various personal factors such as self-efficacy, emotional regulation ability, sleep quality, and psychological resilience have significant implications for their overall health and academic performance. Self-efficacy, a concept introduced by Bandura in his social cognitive theory, refers to individuals' beliefs about their capabilities to accomplish specific tasks. Strong self-efficacy beliefs influence cognition, decision-making, effort, and perseverance. Individuals with high self-efficacy tend to set ambitious goals, invest more effort in pursuing them, and exhibit greater resilience when facing obstacles and setbacks (Etherton et al., 2022). Self-efficacy has a wide-ranging impact on various aspects of behaviour, including choices of actions, persistence in tasks, and the amount of effort put forth. People with high self-efficacy are more likely to select tasks that align with their abilities, choosing meaningful and attainable objectives. Moreover, when confronted with a task, they are inclined to adopt approaches they believe will be most effective in achieving success. The level of self-efficacy directly influences the amount of effort an individual invests in a task and their ability to persevere through challenges.

As successful task completion fosters a belief in one's capacity to achieve in the future, self-efficacy remains a central focus of research in human behaviour and performance. Additionally, self-efficacy has been found to predict physical activity through mediation (Bandura, Freeman, & Lightsey, 1999), and it is associated with various health-related behaviours, including physical activity. A review by Van der Horst et al. (2007) demonstrated a significant positive relationship between self-efficacy and physical activity.

Academic self-efficacy is a concept derived from general self-efficacy, specifically relates to individuals' beliefs about their capabilities in academic tasks (Schunk, 1991). Substantial research has been conducted on academic self-efficacy, with scholars such as Bong (2001), Robbins et al. (2004), and Zajacova et al. (2005) highlighting its crucial role in the learning process. Academic self-efficacy significantly impacts individual development, not only by influencing learning quality but also by shaping effort levels, thought patterns, emotional responses during learning activities, and even interpersonal interactions and personality construction (Sakiz, et al., 2012).

Several researchers have investigated the relationship between self-efficacy and physical activity. Engaging in appropriate physical activity may positively affect academic self-efficacy as it fosters positive physical and mental experiences, such as enhanced physical fitness and improved psychological states. These positive experiences may contribute to an increase in students' academic self-efficacy. Successfully completing a physical task or overcoming a sports challenge may lead individuals to recognise their ability to overcome difficulties and achieve success, which can then extend to the academic domain, elevating academic self-efficacy. Peers

et al. (2020) found that children's physical self-efficacy plays a mediating role in motor ability and physical activity, while a review suggested that physical activity interventions can be beneficial in improving self-efficacy in adolescents (Cataldo et al., 2013). Bandura contends that an increase in self-efficacy is linked to regular exercise habits. However, research on the relationship between physical activity and self-efficacy has been primarily conducted by researchers outside of China, with limited studies conducted by Chinese researchers. Moreover, academic self-efficacy is a distinct expression of self-efficacy in the learning domain. While the findings on the relationship between physical activity and general self-efficacy are insightful, they cannot fully explain the specific relationship between physical activity and academic self-efficacy. Thus, further research is warranted to explore the connection between physical activity and academic self-efficacy.

Emotion regulation refers to how individuals adjust, manage, and express emotions through cognitive, behavioural, and physiological processes (Gross, 2015). The relationship between emotion regulation and physical activity involves various theoretical models. For instance, the two-factor theory posits that physical activity can enhance positive emotions and reduce negative emotions. Engaging in exercise, individuals experience pleasure (positive emotions) while diminishing tension and stress (negative emotions) (Dror, 2017). The emotion discharge theory emphasizes that physical activity can dissipate accumulated negative emotions. Participating in sports can release stress and alleviate tense emotions, bringing emotional equilibrium to individuals (Jekauc et al., 2021). Research indicates a bidirectional relationship between emotion regulation and physical activity. Individuals with stronger emotion regulation abilities may be more motivated to use physical activity as a coping

mechanism, and physical activity, through neurobiological mechanisms, increases positive emotions, thereby positively influencing emotion regulation (Guendelman et al., 2017).

Sleep is an essential aspect of human life and a fundamental prerequisite for maintaining a healthy body. University students are in a critical stage of growth and face considerable academic pressures, making sufficient sleep crucial for their overall well-being. Sleep is a vital process for maintaining physiological balance and restoring bodily functions. Research indicates that insufficient sleep can lead to a decline in immune system function, metabolic disturbances, and hormonal imbalances, thereby increasing the risk of cardiovascular diseases, metabolic syndrome, obesity, and other health issues (Che et al., 2021). Concurrently, learning remains a significant task for university students, involving the processing and retention of vast amounts of information. Adequate sleep contributes to the consolidation of learning material and enhances memory and academic performance. The stage of "deep sleep" during the sleep cycle is closely associated with memory consolidation and retrieval processes (Reyes-Resina et al., 2021). However, recent research has shown a downward trend in the sleep quality of university students. Physical activity has garnered considerable attention as a means of improving sleep quality (Ye et al., 2022). Scholars such as Wang and Boros (2021a; 2021b) have advocated the benefits of moderate physical activity in enhancing sleep quality. For instance, Yang et al. (2023) recommends incorporating Tai Chi exercises to improve the sleep patterns and prevent insomnia.

Psychological resilience refers to an individual's capacity to maintain positive coping and adaptation when facing adversity, challenges, or stress (Troy et al., 2023). For university students, possessing good psychological resilience is evidently

advantageous. Having such resilience enables them to better confront these challenges with a positive mindset and adaptive strategies, rather than being overwhelmed by distress and despondency. During their time in university, the strength of their psychological resilience may determine their susceptibility to stress reactions and psychological disorders. Higher levels of psychological resilience can aid university students in maintaining mental well-being and reducing the risk of issues such as depression and anxiety. Research indicates a positive correlation between engagement in sports activities and psychological resilience. Participating in sports activities can promote physical health among university students, enhancing cardiorespiratory fitness and muscle strength, thus assisting in stress reduction and emotional burden alleviation (Appelqvist-Schmidlechner et al., 2020). Furthermore, sports activities facilitate the release of neurochemicals such as endorphins and dopamine within the body, substances closely associated with emotional regulation and psychological well-being (Bhattacharya et al., 2023). Through regular exercise, university students may find it easier to maintain positive emotions and attitudes, thereby strengthening their capacity to cope with difficulties.

Thus, for the present study, based on the research presented above, the researcher decided to apply the Brain Breaks physical activity intervention among university students. Participants' base level of physical activity, academic self-efficacy, emotion regulation, sleep and resilience could help in determining the effectiveness of Brain Breaks intervention to improve those measured variables. The researcher anticipated a positive impact from this intervention, which could potentially enhance the overall health of university students.

## 1.4 Operational Definition

1. Physical Activity (PA)

Physical activity is any bodily movement resulting in energy expenditure caused by the contraction of skeletal muscles (Caspersen et al.,1985). In this study, BLPAQ was used to assess the physical activity of university students. The BLPAQ is an internet-based questionnaire designed to assess patterns of physical activity, offers a distinctive theoretical framework that distinguishes between planned and unplanned physical activity (Karageorghis et al., 2005).

2. Academic Self-efficacy (ASE)

Academic self-efficacy refers to an individual's confidence and ability assessment regarding their academic tasks and success (Dixon, et al., 2020). By enhancing students' academic self-efficacy, their motivation to learn can be stimulated, their academic performance can be improved, and their success in academic domains can be fostered (Ersanlı, 2015). The present study used the ASES which was developed by McIlroy et al.'s (2000), to assess the ASE among university students.

3. Emotion Regulation (ER)

Emotion regulation is the process through which individuals, in particular contexts, employ strategies to modulate their internal experiences, physiological responses, and behavioural expressions with the aim of attaining emotion regulation objectives. ERQ (Gross & John, 2003) was used in the present study.

4. Sleep

Sleep is a natural, easily reversible, periodic state observed in many organisms, characterized by a lack of wakefulness and a diminished awareness of the surrounding environment. It is accompanied by typical bodily postures (such as lying down with closed eyes), the occurrence of dreaming, and alterations in brain activity and

physiological functions (Dash, 2020). JSS was adopt in this study, which contains four items.

5. Resilience

Resilience in this study refers to psychological resilience. It denotes people's capacity to swiftly rebound and adapt flexibly to an ever-changing environment in the face of stress, frustration, and adversity, transcending personal vulnerability and environmental pressures (Giri & Maurya, 2021; Shi et al., 2019). The 5×5RS was used, it is a noteworthy tool that focuses on assessing five protective factors of psychological resilience by employing both positive and negative expressions (DeSimone et al., 2017).

6. Confirmatory Factor Analysis (CFA)

The CFA is a structural equation model specifically designed for managing measurement models, which depict the relationships between observed variables or indicators and latent variables or factors (Brown & Moore, 2012). As the number of factors does not necessarily match the number of measured variables, it provides a more coarse-grained understanding of the covariation among certain indicators. In this study, the construct validity of the Chinese versions of BLPAQ, ASES, ERQ-8, JSS, and 5×5RS was assessed using CFA.

7. Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) is a statistical technique that integrates factor analysis and multivariate regression analysis. It is employed to examine the structural associations between observed variables and underlying constructs (Kline, 2015). To analyse the structural relationships among PA, ASE, ER, sleep, and psychological resilience in university students, SEM was employed.

8. Brain Breaks

Brain Breaks® Physical Activity Solutions (Brain Breaks) is a web platforms and is developed by HOPSports. The company's exercise programs are designed as brief physical activities aimed at providing children with opportunities for movement during learning and other tasks to enhance their focus, cognition, and memory (Zhou et al., 2021). These physical activity programs are uploaded onto the "Brain Breaks®" web platform, which is developed based on scientific research and educational practices, with the aim of promoting children's learning and physical well-being (Kuan et al., 2019b). In this study, Brain Breaks refers to the physical activity program.

## 1.5 Research Questions, Research Hypothesis, Objectives

Based on the study's progression, the research questions, research hypotheses and objectives, were categorised into Phase 1 and Phase 2.

### 1.5.1 Research Questions

Phase 1

(1) Are the Chinese translated version of questionnaires for Academic Self-efficacy scale, Brunel Lifestyle Physical Activity Questionnaire, The Emotion Regulation Questionnaire-8, Five-by-Five Resilience Scale, and Jenkins Sleep Scale valid and reliable?

(2) Are there any significant path relationships between physical activity, academic self-efficacy, resilience, sleep, and emotion regulation among Chinese university students?

(3) Are there any direct or indirect relationships between physical activity, academic self-efficacy, resilience, sleep, and emotion regulation?

Phase 2

(4) Is there any time effect of Brain Breaks intervention on physical activity, academic self-efficacy, resilience, sleep, and emotion regulation among Chinese university students?

(5) Is there any group effect of Brain Breaks intervention on physical activity, academic self-efficacy, resilience, sleep, and emotion regulation among Chinese university students?

(6) Is there any interaction effect (group*time) of Brain Breaks intervention on physical activity, academic self-efficacy, resilience, sleep, and emotion regulation among Chinese university students?

### 1.5.2 Research Hypotheses

Phase 1

(1) The Chinese-translated versions of the Brunel Lifestyle Physical Activity Questionnaire, Academic Self-efficacy scale, the Emotion Regulation Questionnaire-8, Jenkins Sleep Scale, and Five-by-Five Resilience Scale is valid among university students based on confirmatory factor analysis.

(2) There are significant association between physical activity, academic self-efficacy, resilience, sleep, and emotion regulation in Chinese university students. Specific associations include:

(a) Higher levels of physical activity are expected to be positively correlated with better sleep, emotional regulation, academic self-efficacy, and resilience.

(b) Increased resilience is hypothesized to be linked to reduced sleep disturbances.

(c) Individuals with fewer sleep disturbances are expected to exhibit higher academic self-efficacy and a greater propensity to utilize reappraisal as an emotion regulation strategy.

Phase 2

(3) There is a significant time effect on physical activity, academic self-efficacy, emotion regulation, sleep, and resilience among university students after intervention of Brain Breaks physical activity program.

(4) There is a significant group effect (intervention vs control groups) on physical activity, academic self-efficacy, emotion regulation, sleep, and resilience among university students after intervention of Brain Breaks physical activity program.

(5) There is a significant interaction effect (group*time) on physical activity, academic self-efficacy, emotion regulation, sleep, and resilience among university students after intervention of Brain Breaks physical activity program.

### 1.5.3 General Objective

There were two general objectives of this study. First, to determine the relationship between physical activity, academic self-efficacy, emotion regulation, sleep, and resilience among Chinese university students. While second general objective, to examine the effect of the Brain Breaks intervention on the measured variables among Chinese university students.

### 1.5.4 Specific Objectives

Phase 1

Objective 1: To examine the validity and reliability of the Chinese translated version of questionnaires for Brunel Lifestyle Physical Activity Questionnaire, The Emotion Regulation Questionnaire-8, Jenkins Sleep Scale, Five-by-Five Resilience

Scale, and Academic Self-efficacy Scale, by using confirmatory factor analysis and internal consistency reliability.

Objective 2: To develop a structural equation model to explain the relationships between physical activity, emotion regulation, academic self-efficacy, sleep and resilience.

Phase 2

Objective 3: To examine the changes (within group, time effect) of physical activity, emotion regulation, sleep, resilience and academic self-efficacy before and after the Brain Breaks intervention for intervention and control groups.

Objective 4: To examine the difference between groups (intervention and control groups, group effect) on physical activity, emotion regulation, sleep, resilience and academic self-efficacy after the Brain Breaks intervention.

Objective 5: To examine the interaction effect (group*time) of on physical activity, emotion regulation, sleep, resilience and academic self-efficacy after the intervention of Brain Breaks physical activity program.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Physical Activity

### 2.1.1 Definition of Physical Activity

In an article published by Caspersen et al. (1985) the definition of physical activity was described as "any bodily movement produced by skeletal muscles that requires energy expenditure." This definition has been widely adopted and accepted within the research community, as evidenced by the article's high citation count of more than 15,000 on Google Scholar as of August 2023, indicating its popularity.

The focus of this definition is on the energy expenditure generated by skeletal muscles, which frames physical activity as a specific mechanical behaviour. The authors emphasized the measurement of energy expenditure and proposed that the energy required to perform an activity could be quantified in kilojoules (kJ) or kilocalories (kcal). It is worth noting that 4.184 kJ is roughly equivalent to 1 kilocalorie. Technically, kJ is the preferred unit as a measure of energy expenditure; however, historically, kilocalories (kcal) have been more commonly used as a unit of measuring heat or energy content.

However, with the evolution of time and the shift towards systems thinking and ecological approaches among researchers, there has been a transformation in the understanding of physical activity. The previous definition may not adequately encompass the various cultural values, economic conditions, sports environments, political contexts, and other developments and changes that exist today. Physical activity requires a more comprehensive consideration that takes into account different levels and emphasizes the concepts of complexity and diversity.

In the book "The Politics of Physical Activity" (Piggin, 2019), physical activity is defined as follows: "Physical activity involves the activities, performances, and behaviours of people in specific cultural spaces and contexts, influenced by a range of unique interests, emotions, ideas, instructions, and relationships." The author argues that an expanded definition has more advantages. In the article "What is Physical Activity? A Holistic Definition for Teachers, Researchers and Policy Makers," Piggin (2019) summarizes five advantages of a holistic definition of physical activity:

(1) The new definition prioritises human movement over muscle movement.

(2) It can reflect the productive and creative potential that physical activity brings.

(3) It can problematise the dualism often associated with physical activity.

(4) It may contribute to the reframing of policy interventions, beyond simply using disease risk as a justification.

(5) It can consider the wide range of intrinsic and extrinsic factors specific to each individual's physical activity experience, including interests, emotions, ideas, instructions, and relationships.

Table 2.1 provides a comparison between Caspersen's definition of physical activity and Piggin's definition, highlighting the differences and advantages of the holistic approach.

Table 2.1 Comparison of Definitions of Physical Activity

| Caspersen et al. (1985) | Piggin (2019) |
|---|---|
| Bodily movement | People moving |
| | Acting |
| | Performing |
| Skeletal muscles | Culturally specific |
| | Spaces |
| | Contexts |

Table 2.1 Continued

| | |
|---|---|
| Results in energy expenditure (kilojoules) | Influenced by<br>Interests<br>Emotions<br>Ideas<br>Instructions<br>Relationships |

Certainly, in the context of interdisciplinary development in academic and policy domains related to physical activity, Piggin (2019)'s holistic and comprehensive definition may be more beneficial as it provides a more inclusive perspective. However, in this particular study, considering one of the purposes is to measure the quantity of physical activity, a definition that focuses on the energy expenditure associated with the physical activity itself would be more suitable. Therefore, the use of Caspersen et al.'s definition of physical activity is preferred for this study: "Any bodily movement produced by skeletal muscles that results in energy expenditure". This definition aligns with the author's need to measure the level of physical activity.

### 2.1.2 Physical Activity Guidelines

The World Health Organization (WHO) provides physical activity guidelines recommending that adults aged 18-64 engage in at least 150 minutes of moderate-intensity aerobic activity per week, or 75 minutes of vigorous-intensity aerobic activity per week, or a combination of both. In addition to aerobic activities, it is also advised to perform muscle-strengthening activities involving major muscle groups at least twice a week. Furthermore, reducing prolonged sedentary behaviour and interrupting sitting time through regular activity are emphasized (World Health Organization, 2021).

However, research has shown that the majority of adults spend more than 8 hours sedentary each day, and this trend is on the rise (Yang et al., 2019). A survey

conducted in 2016 revealed that 27.5% of adults worldwide lack physical activity (Guthold et al., 2018). Furthermore, the proportion of women globally who lack physical activity (31.7%) is significantly higher than that of men (23.4%) (Guthold et al., 2018). Research indicates that Chinese female university students have significantly higher sedentary time compared to male university students (7.63 hours/day vs. 7.26 hours/day) (Ge et al., 2019). Particularly during the COVID-19 pandemic, numerous studies have shown a decline in physical activity levels among adults. In Chile, national data from a survey on physical activity and exercise habits among individuals aged 18 years and above revealed that 81.3% of the population lacked physical activity (Duclos-Bastías et al., 2022). In Italy, Maugeri et al. (2020) conducted an epidemiological analysis involving 2524 Italian participants aged 18 to 70 years, which indicated a moderate decline in physical activity levels. There was a 6% decrease in moderate exercise and an 11% decrease in vigorous exercise. In China, Yu et al. (2022) investigated the physical activity levels of 1487 students, and the results demonstrated an overall reduction in minutes of intense physical activity by 27.89% per week (40.62 minutes), moderate physical activity by 43.38% per week (73.92 minutes), and walking by 24.36% per week (44.69 minutes). Despite the World Health Organization's ongoing efforts over the decades to improve physical activity and reduce sedentary behaviour, with a target of reducing insufficient physical activity by 15% by 2030 (World Health Organization, 2020), achieving this goal requires substantial changes in physical activity behaviours among a larger population, which appears to be a challenging transition.

### 2.1.3 The Consequences of Insufficient Physical Activity

Insufficient physical activity is a major risk factor for obesity and metabolic disorders. A lack of exercise can result in inadequate energy expenditure, leading to weight gain and an increased risk of chronic conditions such as diabetes, hypertension, and cardiovascular diseases (Mozaffarian, 2016). Prolonged sedentary behaviour is also associated with obesity and metabolic disturbances, as prolonged sitting reduces basal metabolic rate and affects fat metabolism (Park et al., 2020). There is a close association between insufficient physical activity and cardiovascular diseases as well. Regular participation in aerobic exercise has been shown to reduce the risk of cardiovascular diseases, including heart disease, stroke, and hypertension (Alves et al., 2016). Research has indicated that active physical activity can lower blood pressure, and in adults with normal blood pressure, there is a negative dose-response relationship between physical activity (PA) and the incidence of hypertension. Moreover, engaging in regular physical activity can reduce the risk of cardiovascular disease progression in individuals with hypertension (Pescatello et al., 2019).

### 2.1.4 Measurement of Physical Activity

In current methods for measuring physical activity, both objective and subjective measurement approaches are utilized. Commonly used objective measurement methods include:

Accelerometers: Accelerometers are commonly used tools for objectively measuring physical activity. By measuring changes in acceleration in various body parts, activity levels can be inferred. Accelerometers can be incorporated into wearable devices (such as wristbands or waist belts) or embedded devices (such as smartphones or smartwatches) (Blackwood et al., 2022).

Heart Rate Monitoring: Heart rate monitoring is a method for measuring the intensity of physical activity. There is a relationship between heart rate and activity level, and by monitoring changes in heart rate, an individual's activity level and energy expenditure can be assessed (Gilgen-Ammann et al., 2019).

Metabolic Measurement: Metabolic measurement is a direct method for measuring an individual's energy expenditure. By measuring an individual's oxygen consumption and carbon dioxide production, their energy expenditure can be accurately evaluated (Hills et al., 2014).

Objective measurement methods have the advantage of high objectivity and accurate data, providing precise information on physical activity. However, objective measurement methods also have certain limitations. These limitations include such as: Technological Constraints: Some objective measurement methods may require specific devices or technologies, which can limit their applicability and feasibility in certain settings or populations; Lack of Contextual Information: Objective measurement methods typically provide information only on the quantity and intensity of physical activity, lacking detailed descriptions of activity types, environmental conditions, and individual experiences.

Subjective measurement methods, such as questionnaires, diary records, and self-reports, are commonly used. Among these, questionnaire surveys are the most prevalent method for measuring physical activity. In the existing literature, the main questionnaires that have been utilized include:

(1) The International Physical Activity Questionnaire (IPAQ): Developed by a group of experts in 1998 (Craig et al., 2003), the IPAQ has two versions: a 31-item long form (IPAQ-LF) and a 9-item short form (IPAQ-SF). It includes questions regarding different types of activities, their frequency, duration, and intensity, covering aspects

such as walking, moderate-intensity activities, and vigorous-intensity activities. The IPAQ has become one of the most widely used questionnaires for assessing physical activity (van Poppel et al., 2010).

(2) The Global Physical Activity Questionnaire (GPAQ): Developed by the World Health Organization (WHO) based on the IPAQ, the GPAQ is a commonly used questionnaire for assessing physical activity levels across different age groups. The questionnaire focuses on three domains: occupational physical activity, transportation-related physical activity, and leisure-time physical activity (Chu et al., 2015). For each domain, there is a predefined list of physical activities to assist participants in recalling their physical activity engagements.

(3) The Exercise Benefits/Barriers Scale (EBBS): Developed by Sechrest et al. (1987), the EBBS is a questionnaire consisting of 43 items across 9 factors. Out of these, 29 items assess exercise benefits, while 14 items assess exercise barriers (28). This scale is used to assess individuals' perceptions of the benefits and barriers to exercise, as well as their attitudes and beliefs towards exercise.

(4) The Brunel Lifestyle Physical Activity Questionnaire (BLPAQ): The BLPAQ is designed to assess the planned and unplanned components of lifestyle physical activity (LPA), specifically planned physical activity (PPA) and unplanned physical activity (UPA).

Reasons for choosing BLPAQ in the present study:

This questionnaire has been established as a valid and reliable tool for evaluating physical activity patterns within the British population and has also undergone validation in the Turkish language (Erkılıç et al., 2021). Furthermore, the BLPAQ has been successfully utilized in various studies involving English-speaking populations (Drew et al., 2019; Karageorghis et al., 2021; Quinn et al., 2020; Shih et al., 2022).