The Relationships Between Self-efficacy, Social Support and Physical Activity in Chinese College Students

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Authorization to Submit Dissertation

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Abstract

The complex mechanism on how intrapersonal and interpersonal components are associated with physical activity under the framework of the Ecological Systems Theory is intriguing, but few studies have shed lights on it in Chinese college populations. This study examined the structural relationships between self-efficacy, social support and physical activity among Chinese college students. A total of 460 Chinese college students (254 men and 206 women) completed the questionnaires assessing self-efficacy, social support from family and friends, and physical activity in the domains of work, travel and recreation. The Structural Equation Modeling was used to investigate how social support from family and friends were directly and indirectly associated with physical activity when self-efficacy acted as the mediator. The results suggested that self-efficacy fully mediated the relationships between social support from friends and recreational physical activity, while social support from family was directly associated with work, travel and recreational physical activity. In addition, female students reported lower self-efficacy and less work and recreational physical activity than male students. Students in higher grade engaged in less travel and work physical activity than those in the lower grade. This study aided in the understanding of how self-efficacy and social support may predict physical activity behaviors in different domains among Chinese college students. Health educators should consider the interpersonal and intrapersonal factors as a useful combination when promoting physical activity in college settings.

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I would like to thank Dr. David Paul for his support and guidance in serving as my major professor and mentor. I would like to thank my committee members, Dr. Audrey Fu, Dr. Chun-Chu Chen and Dr. Stephen Lee for being wonderful mentors to me during my time at the University of Idaho. Thank you for all of your help, advice and feedback! I would also like to thank the Department of Movement Sciences and the Department of Statistical Sciences for supporting me to pursue two degrees at the same time.

Dedication

I dedicate this work to my parents and family for their love and support.

Table of Contents

List of Tables

List of Figures

1. Introduction

The benefits of engaging in regular physical activity have been well-documented, including prevention of cardiovascular diseases (Weinstein et al., 2008), obesity (Ladabaum, Mannalithara, Myer, & Singh, 2014), certain forms of cancer (Moore et al., 2016), bone and joint diseases (Kohrt, Bloomfield, Little, Nelson, & Yingling, 2004), and depression (Dunn, Trivedi, & O'Neal, 2001). Overall, physical inactivity is considered as an important contributor to non-communicable diseases not only in high-income countries, but low- and middle-income countries as well (Bauman et al., 2012). Therefore, the promotion of physical activity has received a significant amount of attention in public health fields as a mean to reduce the prevalence of non-communicable diseases and improve quality of life.

Extensive research on the optimal level of physical activity for health has led to the development of physical activity guideline for adults. For example, the American College of Sports Medicine and the American Heart Association recommended that "To promote and maintain health, all healthy US adults aged 18 to 65 yr need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days each week" (Haskell et al., 2007). These recommendations indicate that both the duration and intensity of physical activity must be considered to optimize the health benefits of physical activity and lower the risk of cardiovascular disease and premature mortality. Similarly, a large prospective cohort study of Chinese adults living in Taiwan suggested that a minimum 90 minutes of moderate intensity physical activity per week had significant health benefits (Wen et al., 2011).

Although the benefits of physical activity are well-documented, physical inactivity is becoming a key public health concern. In China, rapid economic growth and urbanization are associated with the increased adoption of inactive lifestyles (Monda, Gordon-Larsen, Stevens, &

Popkin, 2007). The 2007 Chinese Behavioral Risk Factor Surveillance Survey (BRFSS) suggested that 31.1% of Chinese aged 15-69 years did not meet the targets for recommended healthy levels of physical activity (China CDC, 2010). Unfortunately, physical inactivity has remained an understudied field in China (Zhang & Chaaban, 2013), since the majority of recent research studying various correlates of physical activity have been carried out in Western, high-income countries (Bauman et al., 2012).

College students represent a major segment of the young adult population (Leslie et al., 1999), and the dynamic transitional period from adolescence into young adulthood during college is characterized by rapid changes in body, mind, and social relationships (Pullman et al., 2009). While students experience a new environment in college, they may face the temptations of negative health behaviors including physical inactivity. Previous studies indicate that psychological (e.g. self-efficacy), social (e.g. social support from family and friends), and environmental factors (e.g. built environment, access to facilities) may influence college students' physical activity behavior (Keating, Guan, Piñero, & Bridges, 2005). Unfortunately, 40 to 60% of Chinese college students do not participate in an adequate amount of physical activity to gain health benefits (China's Department of Education, 2000), therefore it is important to investigate the multilevel correlates of physical activity patterns and their interrelationships in Chinese college students.

Since physical activity is influenced by a diverse array of social and physical environmental variables, the Ecological Systems Theory has been applied to study the correlates of physical activity (Bauman et al., 2012). The EST suggests that different contextual factors construct overlapping layers of ecological systems (Bronfenbrenner & Morris, 2006). Individuals are influenced by a variety of micro-environments or settings (e.g. schools, homes, and workplaces), which in turn, are interrelated with the macro-environments (e.g. government, society's cultures and beliefs)(Sallis et al., 2006). The theory considers the interrelations and interactions between intra- and inter-personal factors and their surrounding environments (physical, culture, and policy). Therefore, the purpose of this study is to draw upon the EST to examine the interrelationships between self-efficacy, social support and physical activity while considering their potential relationships with sedentary behavior among Chinese college students in the microsystems. Beyond the microsystem, the mesosystem captures the dependency and difference between two micro-settings (family and friends), whereas the macrosystemic variables were not examined in this study. As the total physical activity comprises domain-specific work, travel and recreational activity, a notable shift from measuring total physical activity to tracking physical activity within different domains (Bull, Maslin, & Armstrong, 2009). Two hypothesized structural models were constructed to investigate the outcomes of total physical activity and physical activity in different domains separately, while considering the individuals' sedentary behavior. The model one examined the relationships of self-efficacy, social support to total physical activity and sedentary behavior, while the model two tested the associations of self-efficacy, social support to work, travel and recreational physical activity as well as sedentary behavior. The hypothesized structural model one and two are presented in Figures 1.1 and 1.2.

Assuming that our target population includes college students with similar demographic characteristics as the samples of this study, we formed seven hypotheses based on the hypothetical models as follow:

- H1: Social support from family and friends would be positively associated with self-efficacy.
- H2: Social supports from family and friends would be positively associated with total physical activity engagement.
- H3: Self-efficacy would be positively associated with total physical activity engagement.
- H4: Self-efficacy would mediate the relationships between social support from friends and family and total physical activity engagement.

- H5: Social supports from family and friends would be positively associated with participation in recreational physical activity, work-related physical activity, and travel activity.
- H6: Self-efficacy would be positively associated with participation in recreational physical activity, work-related physical activity, and travel activity.
- H7: Self-efficacy would mediate the relationships between social support from friends and family and participation in recreational physical activity, work-related physical activity, and travel activity.
- H8: Social support from family and friends would be negative associated with weekly duration of sedentary behavior.

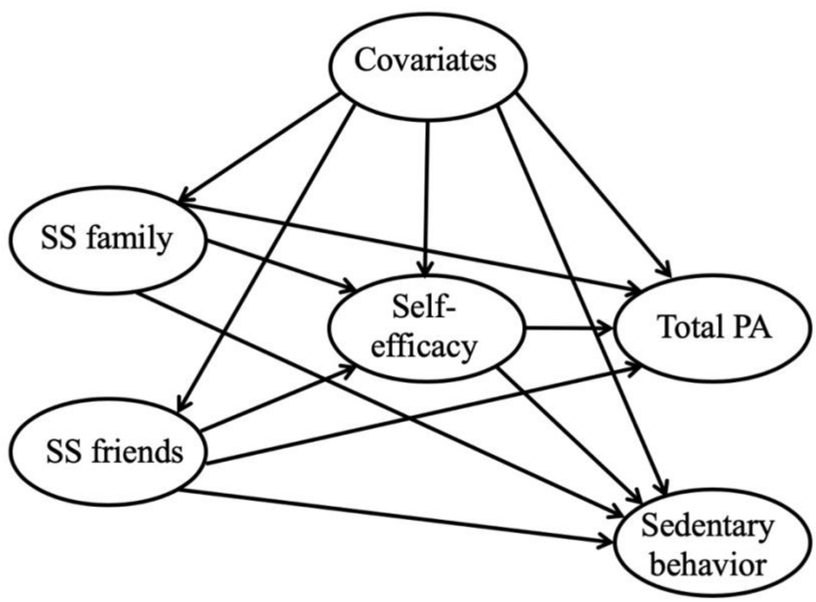

Figure 1.1: Hypothesized structural model one. SS = social support; PA = physical activity; covariates include sex, age, grade and academic major; the outcome variables are total PA and sedentary behavior.

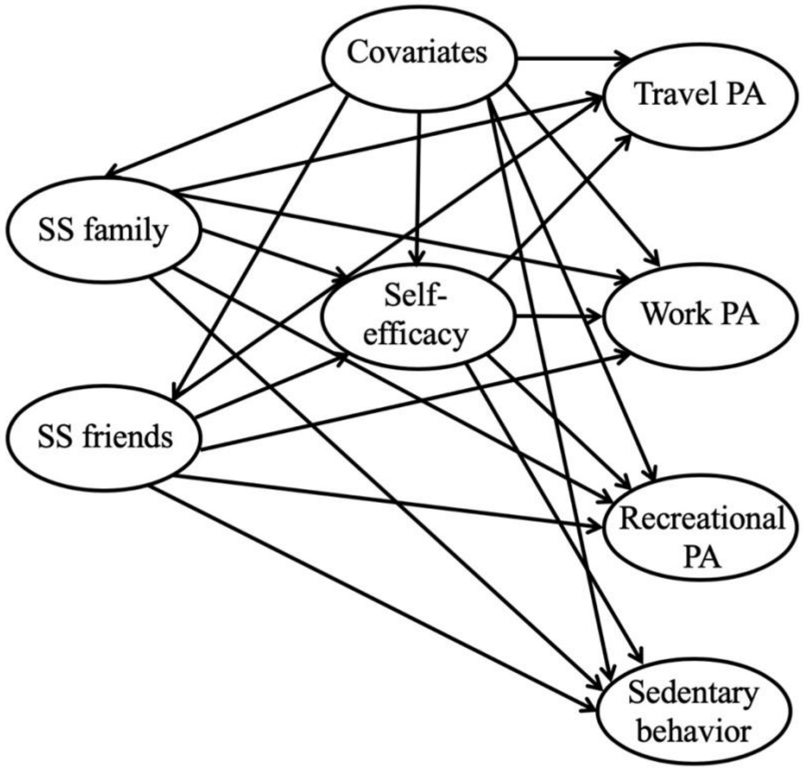

Figure 1.2: Hypothesized structural model two. SS = social support; PA = physical activity; covariates include sex, age, grade and academic major; the outcome variables are work PA, travel PA, recreational PA, and sedentary behavior.

2. Literature review

2.1 Physical activity

Within the framework of health-related research, physical activity is defined as "any bodily movement produced by skeletal muscle that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985). Although the term "exercise" may be used interchangeably with "physical activity", exercise refers to "the subset of physical activity that is planned, structured, and repetitive, and has a final or an intermediate objective of the improvement or maintenance of physical fitness" (Caspersen et al., 1985). Physical activity contains four dimensions: frequency (sessions/unit time), intensity (rate of energy expenditure), time and type (Must & Tybor, 2005). To quantify the intensity, physical activity can be expressed as a metabolic equivalent (MET), which is comparable to the energy expended by most people to sit quietly (1 kilocalorie/kilogram body weight/hour). Moderate intensity activities are ones that consume 3 to 6 times as much energy as individuals do when sitting quietly (3-6 METs), while vigorous intensity activities consume more than 6 METs. Finally, physical activity can also be categorized as a complex set of behaviors, such as leisure-time physical activity active transportation, and occupational and domestic activities (Pate et al., 1995).

In 1995, the Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) issued a physical activity recommendation that “Every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week” as the minimum amount of activity for health (Pate et al., 1995). Subsequent literature has reaffirmed the role of duration and intensity of physical activity in reducing the risk of chronic illness and emphasized the dose-response relationship between physical activity and health benefits (Haskell et al., 2007). Therefore, the ACSM/AHA guidelines were updated in 2007 by recommending that “to promote and maintain health, all healthy adults aged 18 to 65 yr need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days each week" (Haskell et al., 2007).

Physical activity has become a focus of public health research due to its role in the reduction of risk for chronic diseases. Although the protective effects of physical activity are well-documented, 31% of the world's adult population (ranging from 17% in South-East Asia to approximately 43% in the Americas and the Eastern Mediterranean region) do not meet the minimum recommendations for physical activity (Hallal et al., 2012). Based on the Global Health Observatory data from the World Health Organization (WHO), 23% of adults (20% of men and 27% of women) were insufficiently active (World Health Organization, 2010). Although young adults were more active than older adults, 19% of young adults did not meet the recommended level of physical activity (World Health Organization, 2010).

College students represent a major segment of the young adult population, and they are in the transition stage from late adolescence to adulthood (Leslie et al., 1999). Unfortunately, inactivity is common among college students. A recent study using data from 17,928 undergraduate students from 24 universities in 23 countries showed that the overall prevalence of physical inactivity was 41.4%, ranging from 21.9% in Kyrgyzstan to 80.6% in Pakistan (Plotnikoff et al., 2015). Similarly, Haase and colleagues (2004) surveyed 19,298 college students from 23 countries and revealed that the prevalence of physical inactivity ranged from 23 to 39% in western countries, and to 44% in developing countries. Irwin (2004) reviewed 19 studies including students from 27 countries, which showed that more than one-half of college students from the United States and Canada did not engage in enough physical activity to gain health benefits. These trends represent a potential public health concern since unhealthy habits, such as physical inactivity, often persist into later life and may be associated with long-term negative health outcomes (Friedman et al., 2008).

The development of higher education in China has been dramatic in recent years. For example, in 2016 there were 26.9 million college students in China, compared to 15.6 million in 2005 (Ministry of Eudcation of the People's Republic of China, 2016). Approximately 40 to 60% of Chinese college students do not engage in adequate amounts of physical activity, and there is a reported decline in physical activity levels with each year in college (China's Department of Education, 2000). Multilevel factors may concurrently influence the increasing adaptation of the inactive lifestyle among Chinese college students. In contrast to the general young adult population, Chinese college students bear severe academic pressure, so that much of their time and energy may be occupied with their studies. On the other hand, screen-based technologies, such as the computer and video games, provide popular entertainment choices among college students, which reduce the interest in exercise (Wu, Tao, Zhang, Zhang, & Tao, 2015). In some colleges, the lack of exercise facilities may also be a major reason why students are physically inactive (Wang, Ou, Chen, & Duan, 2009).

Although China has the largest college student population in the world (Abula, Gröpel, Chen, & Beckmann, 2018), the majority of previous research on physical activity among university students was conducted in high-income countries (Pengpid et al., 2015). Therefore, further research is needed to understand Chinese college students' physical activity patterns and the factors influencing them.

2.2 Health benefits of physical activity

The benefits of physical activity have been well-established in previous literature, as regular physical activity is associated with a reduction in the risk of many diseases including cardiovascular diseases (Weinstein et al., 2008), obesity (Ladabaum et al., 2014), some kinds of cancer (Moore et al., 2016), bone and joint diseases (Kohrt et al., 2004), and depression (Dunn et al., 2001). For example, the rate of obesity is at epidemic proportions in many developed and developing countries, which poses a major concern due to the high risk of accompanying comorbid disorders, such as Type II diabetes, cardiovascular disease, and cancer (Pi-Sunyer, 2009). Fortunately, physical activity appears to play a critical role in obesity prevention (Rippe & Hess, 1998).

In 2009, ACSM published a Position Stand indicating that engaging in 150 to 250 min/wk of moderate-intensity physical activity may be effective for preventing weight gain and providing modest weight loss (Donnelly et al., 2009). In addition, engaging in greater than 250 min/wk moderate-intensity physical activity has been associated with marked weight loss and 200 to 300 min/wk of physical activity was recommended during weight maintenance after weight loss (Donnelly et al., 2009). Fortunately, achieving these physical activity guidelines may attenuate increased chronic disease health risks, such as increases in high density lipoprotein cholesterol (HDL-C) and decreases in triglycerides (TG), despite modest weight loss of less than 3%. However, the Position Stand notes that there are health benefits for engaging in physical activity whether weight is lost or not.

The health benefits of domain-specific physical activity have been a focal point in the literature. A number of studies on occupational and leisure-time physical activity have reported a reduced incidence of cardiovascular diseases in more physically active individuals (Thompson et al., 2003). A meta-analysis of 33 prospective cohort studies published since 1995 showed that individuals who engaged in 150 minutes per week of moderate intensity leisure-time physical activity had a 14% lower coronary heart disease risk than those who reported no leisure-time physical activity (Sattelmair et al., 2011). Similarly, another meta-analysis of 21 prospective studies with a sample size of more than 650,000 adults revealed that the relative risks of cardiovascular diseases in the group with the highest level of leisure-time physical activity were 0.76 and 0.73 for men and women, respectively, compared to the groups that engaged in the lowest level of leisure-time physical activity (Li & Siegrist, 2012).

Overall, more studies have been conducted on leisure-time physical activity than occupational physical activity (Howley, 2001).Li and Siegrist (2012) reported lower risks of cardiovascular disease in individuals engaging in moderate levels of occupational physical activity than those engaging in low occupational physical activity (RR in men = 0.89; RR in women = 0.83). It is worth noting that high levels of occupational physical activity may not result in a protective effect on cardiovascular diseases (G. Hu et al., 2007; Li & Siegrist, 2012).

In addition to leisure time and occupational physical activity, active commuting (such as cycling and walking to work) may provide feasible methods of increasing physical activity and preventing cardiovascular disease. Despite the limited amount of data, a meta-analysis of eight studies demonstrated a robust protective effect of active commuting on the cardiovascular diseases when compared to non-active commuters (RR = 0.89)(Hamer & Chida, 2008). Moreover, a study using population-based data from the Coronary Artery Risk Development in Young Adults (CARDIA) study found that active commuting was inversely associated with TG levels, diastolic blood pressure, and fasting insulin, and positively associated with HDL-C in men (Gordon-Larsen et al., 2009). More recently, a prospective population-based study in the UK showed that commuting by cycling and walking were associated with a lower risk of cardiovascular incidence (cycling hazard ratio = 0.54; walking hazard ratio = 0.73) when compared to a non-active commuting group (Celis-Morales et al., 2017).

Literature has also shown that engaging in physical activity may significantly decrease the risk of premature all-cause mortality (I.-M. Lee & Skerrett, 2001; Rhodes, Janssen, Bredin, Warburton, & Bauman, 2017). For instance, a review conducted by Lee and Skerrett (2001) revealed an inverse linear dose-response relationship between volume of physical activity and all-cause mortality in men and women, and that adherence to physical activity guidelines (an energy expenditure of about 1000 kcal/wk) is associated with a significant 20 to 30% reduction in the risk of all-cause mortality. Arem and colleagues (2015) observed a 39% lower mortality risk among individuals engaging in 3 to 5 times the recommended minimum of 7.5 METs per week.

Recent research has also documented the benefits of physical activity at doses below the recommended levels. Wen and colleagues (2011) reported that individuals in a low-volume activity group who performed 15 min a day or 90 min a week of moderate intensity physical activity had a 14% lower risk of all-cause mortality compared with those in the inactive group. Moreover, a meta-analysis of prospective cohort studies showed that older adults who performed a dose of moderate-to-vigorous intensity physical activity (MVPA) below recommended level had a 22% reduction in mortality compared with those reporting no MVPA participation (Hupin et al., 2015).

Higher levels of domain-specific physical activity may also be associated with reduced all-cause mortality. A meta-analysis using data from 80 studies with 1,338,143 participants revealed that lower all-cause mortality was associated with higher levels of leisure activity [combined risk ratio (RR) = 0.74], activities of daily living (combined RR = 0.64), and occupational activity (combined RR = 0.83)(Samitz, Egger, & Zwahlen, 2011). Similarly, a study from Denmark showed that lower mortality rates were not only found in men and women who were engaged in leisure-time physical activity, but also in ones who reported cycling to work (Andersen, Schnohr, Schroll, & Hein, 2000).

2.3 Self-efficacy

Self-efficacy is defined as “the belief or confidence in one’s capabilities to organize and execute the courses of action required to produce given attainment” (Bandura, 1997). Bandura (1997) identified four sources of self-efficacy, namely 1) personal accomplishment or mastery; 2) vicarious experience; 3) verbal persuasion; 4) emotional arousal. Personal accomplishment or mastery refers to successful experience (or performance) of the target behavior, which ought to enhance the perception of efficacy. Vicarious experience refers to appraising one’s own performance against a “similar other" successful performance. Verbal persuasion refers to the faith in one's capabilities from other individuals. Emotional arousal, either excitement or anxiety, indicates the feelings of mastering a task. Among these resources, personal accomplishment or mastery may be considered the most influential source of self-efficacy (Bandura, 1997; McAuley & Blissmer, 2000).

Confidence in personal ability to perform physical activity (i.e. self-efficacy) may be an important motivational regulator of this behavior (McAuley & Blissmer, 2000). Among many correlates of physical activity, self-efficacy demonstrated the strongest and most consistent associations with physical activity in adults (Trost, Owen, Bauman, Sallis, & Brown, 2002). One meta-analysis also reported that self-efficacy was one of the largest correlates of physical activity ($r = 0.35$)(Spence et al., 2006). In a summary of the current literature, four out of seven reviews showed consistent evidence of a positive association between self-efficacy and physical activity (Bauman et al., 2012).

Additional evidence in the form of intervention studies has also reported the impact of self-efficacy on physical activity (Williams & French, 2011). A meta-analysis of interventions promoting physical activity reported a positive relationship between changes in self-efficacy and changes in physical activity (Williams & French, 2011). In contrast, there are some studies that have revealed non-significant relationships between self-efficacy and physical activity. For example, Morey and colleagues (2003) conducted a clinical trial of 112 sedentary adults who were randomly assigned to one of two exercise interventions; self-efficacy was not a strong predictor of exercise behavior. In addition, other investigations have suggested that while self-efficacy may be correlated with short-term exercise initiation, it may not have a significant impact on exercise maintenance (Oman & King, 1998; van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009).

In the mediation analysis, the mediating variable is intermediate in the causal path from an independent variable to a dependent variable, such that the independent variable causes the mediator which then causes the dependent variable (MacKinnon, 2012). In other words, the independent variable has an indirect effect on the dependent variable through the mediator (Shrout & Bolger, 2002). As an intrapersonal factor, self-efficacy often acts as mediator in model-based research. For example, Parschau and colleagues (2013) tested the mediating role of self-efficacy in the experience-behavior relationship and found that self-efficacy mediated the relationship between the initial positive experience, and later physical activity. Warner, Schüz, Knittle, Ziegelmann, and Wurm (2011) investigated four sources of self-efficacy and showed that past experience, vicarious experience and subjective health had significant indirect effects on exercise via self-efficacy. Moreover, Duncan and McAuley (1993) tested the mediating effect of self-efficacy in a sample of 85 middle-aged adults and revealed that social support indirectly influenced exercise behavior through self-efficacy [the indirect effect = 0.417 ($t = 3.492$)].

A positive relationship between self-efficacy and physical activity has also been found in college-aged populations. For instance, Sullum and colleagues (2000) conducted a longitudinal study to identify predictors of exercise relapse and maintenance among physically active US college students ($n = 52$). The results suggested that college students with higher self-efficacy at baseline were less likely to relapse ($t = 2.64$, $p = 0.01$). Nevertheless, the differences in follow-up change scores for self-efficacy were not significant between relapsers and maintainers (Sullum et al., 2000). Another study that examined the levels of self-efficacy and physical activity rates in a group of college students (ones that entered a fitness facility) reported that self-efficacy was positively associated with the frequency of physical activity ($r = 0.462$, $p < 0.05$) and contributed nearly 8% of the variance in the frequency of physical activity (Hutchins, Drolet, & Ogletree, 2010). Lee and Young (2018) investigated the roles of social support, self-efficacy and behavioral change in physical activity among Korean college students ($n = 164$). The results indicated that self-efficacy had an indirect effect (ß = 0.29) on physical activity through physical activity stages of change and that social support for physical activity was positively correlated with self-efficacy ($r = 0.45$, $p < 0.001$).

The relationships between self-efficacy and physical activity have not been well-researched in Chinese college students. Xu et al. (2017) conducted a cross-sectional study including 1,976 Chinese college students and found that individuals who had high self-efficacy scores engaged in more leisure-time physical activity. Shen and Xu (2008) examined the influences of self-efficacy, body mass and cardiorespiratory fitness on Chinese college students' exercise motives, which is a driving force for students' actual physical activity and exercise engagement. The results revealed that students with higher cardiorespiratory fitness were more likely to have higher self-efficacy in exercise than ones with lower cardiorespiratory fitness ($r = 0.39$, $p < 0.01$) Furthermore, self-efficacy had positive impacts on exercise motives for psychological, interpersonal and fitness reasons among male students and motives for interpersonal and body-related reasons among female students, which may have additive effects on exercise adherence (Shen & Xu, 2008).

2.4 Social support

Social support has been identified as a key determinant in physical activity promotion (Bauman et al., 2012). There are four categories of social support, which fall under two mechanisms: tangible and intangible (Beets, Cardinal, & Alderman, 2010). Tangible social support includes instrumental (purchasing equipment/payment of fees and transportation) and conditional support (doing the activity with and watching/supervising), while intangible social support contains motivational (encouragement and praise) and informational support (discussing benefits of physical activity)(Beets et al., 2010).

Social support from family and friends has been consistently found to be positively associated with physical activity across a wide range of population groups (Bauman et al., 2012; Trost et al., 2002). In the review conducted by Trost et al. (2002), all relevant studies found significant associations between social support and physical activity in adults. Furthermore, Stahi and colleagues

(2001) examined the relationships between physical activity and social and environmental support among 3,342 adults from six countries (Belgium, Finland, Germany, The Netherlands, Spain and Switzerland), and reported that individuals who perceived low social support from their personal environment (i.e. family, friends, school and workplace) were more than twice as likely to be physically inactive in contrast with those who reported high social support (odds ratio = 2.02, $p < 0.001$). Adopting a social-ecological perspective, a cross-sectional study was conducted to examine the associations between multifaceted individual and environmental factors and habitual physical activity among Chinese older adults recruited from ten communities in Shangdong province, China (Yi et al., 2016). It revealed that participants who had high levels of perceived social support reported higher levels of physical activity engagement (ß = 0.393, $p < 0.001$).

However, it is worth noting that not all studies exhibit significant relationships between social support and physical activity. For instance, Stiggelbout and colleagues (2005) conducted a prospective cohort study with measurements taken at baseline and after six months to examine the behavioral predictors of maintenance of exercise participation among 1725 older adults. Although a high self-efficacy at baseline was significantly associated with the intention to continue with the exercise program (odds ratio = 1.73, CI 1.09-2.75), social influences (i.e., subjective norms, perceived social support and modeling) did not predict either intended or actual maintenance of exercise participation.

Due to limited data reported in the literature, the association between social support and active travel is unclear. A systematic literature review found that only three of six studies reported significant relationships between social support and active travel (Panter & Jones, 2010). For example, a study using data from 1,282 women in Australia showed that social support from family, but not friends, was significantly associated with walking for transportation (Ball et al., 2007). Friends' social support, however, was associated with leisure-time walking (Ball et al., 2007). In addition, De Geus and colleagues (2007) examined psychosocial and environmental predictors of cycling for transportation among 343 Flemish adults and revealed that participants who had social support were more likely to cycle for transportation (odds ratio = 2.26, 95% CI 1.20 – 4.27).

From a social cognitive perspective, social support may serve as a source of efficacy information, and the effects of social support on physical activity may be mediated by self-efficacy (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). In a 6-month randomized controlled trial with an 18-month follow-up, McAuley et al. (2003) found a significant path from social support to self-efficacy (ß = 0.30, $p < 0.05$) and in turn, self-efficacy was related to physical activity at the 6- (ß = 0.27, $p < 0.05$) and 18-month (ß = 0.52, $p < 0.05$) follow-up in older adults. Resnick and colleagues (2002) tested the relationships among social support, self-efficacy and exercise behavior in a sample of older adults (n = 74) living in a continuing care retirement community. The results suggested that support of friends indirectly influenced exercise through self-efficacy (ß 1 = 0.22, $p <0.05$; ß 2=0.40, $p <0.05$). However, the direct association between friend support and exercise behavior was not significant, suggesting that this relationship was fully mediated by self-efficacy. Yi et al. (2016) acknowledged that, although not measured in their study of Chinese older adults, social support may affect physical activity indirectly through one's perception of self-efficacy and recommended expanding the current model to take into account the mediational relationship in future studies.

College life appears to offer both risk and opportunity regarding physical activity behavior, as social support may become increasingly important for maintaining regular physical activity (Sylvia-Bobiak & Caldwell, 2006). A prospective longitudinal study examined a multidimensional model of social support and physical activity among 819 undergraduate students during their first year of college (Scarapicchia, Sabiston, Pila, Arbour-Nicitopoulos, & Faulkner, 2017). The researchers found that students reported participating in higher amounts of physical activity when they had a stronger social network from family (ß = 23.20) and perceived social support from friends (ß = 34.87). Rovniak and colleagues (2002) surveyed 277 university students to examine the relationship between several social cognitive variables and physical activity. The results indicated that support from friends indirectly predicted physical activity through its effect on self-efficacy. Comparing with the relationship between self-efficacy and physical activity (ß = 0.71, $p < 0.001$), social support only exhibited a moderate effect on physical activity (ß = 0.28, $p < 0.001$). Similarly, Sylvia-Bobiak and Caldwell (2006) tested a model of physical activity participation among college students, and revealed that peer and family support had moderate direct effects on self-efficacy (ß1 = 0.27, $p < 0.01$; ß2 = 0.29, $p < 0.01$), while self-efficacy had a large direct effect on leisure-time activity (ß = 0.40, $p < 0.01$).

Using the youth physical activity promotion model, Yan, Cardinal, and Acock (2015) examined factors that influence physical activity among Chinese international college students in the United States. In the mediation analysis, the results showed no direct effects of social support on meeting physical activity recommendations, whereas social support had indirect effects on physical activity through the predisposing factors (i.e. self-efficacy, enjoyment, and attitude).

In addition, social support, especially from peers, may be associated with active travel in a college-aged population. Titze and colleagues (2007) examined the association between a variety of factors and cycling for transportation among 538 college students, and found that students who had many other friends that cycled to university were more than twice as likely to cycle regularly than those who did not have many friends cycling. Furthermore, Yuan, Lv, and VanderWeele (2013) surveyed Chinese college students who lived in university dormitory rooms and found that the odds of college students' usage of bicycling increased about four times if their roommates were bicycling.

In summary, it appears that social support from family and friends may pose a positive influence on an individual's engagement in physical activity. However, there is insufficient evidence to support this conclusion in Chinese college populations. Further studies are warranted to examine the relationships between social support, self-efficacy and physical activity in different domains in the Chinese college population.

2.5 The ecological models

Ecological models that highlight multi-system interactions between physical and sociocultural environments have become increasingly utilized in behavioral sciences and public health. The strength of these models is related to their ability to influence health by integrating behavioral models that focus on intrapersonal characteristics and social interactions, with broader influences at the community, organizational and policy levels (Sallis et al., 2006). Authoritative documents issued by the World Health Organization (2004) promote the application of ecological models to achieve changes in health behaviors. Due to the multi-disciplinary attributes of ecological models, the collaboration between a wide range of disciplines (such as public health, behavioral sciences, urban planning, transportation, recreation studies and public policy) allows multiple perspectives and strengths to be brought to the research agenda (Sallis et al., 2006).

Sallis and colleagues (2006) created an ecological framework that identifies intrapersonal (biological, psychological), interpersonal/cultural, organizational, physical environment (built, natural), and policy (law, rules, regulations, codes) that influences four domains of active living: recreation, transportation, occupation, and household. All four domains of activity are important influences for understanding physical activity in different populations. Support for this model comes from the literature showing that occupational, household and transportation domains are the most common physical activity types in low- and middle-income countries, while leisure-time physical activity is the major part of total physical activity in high-income countries (Bauman et al., 2012).

Given that social and physical environments are increasingly being recognized as contributors to physical inactivity, researchers have generally reached a consensus that ecological models may provide sound theoretical frameworks to study the correlates of physical activity (Bauman et al., 2012). In turn, applying ecological models to understand why populations such as college students engage in physical activity may be essential for future intervention efforts that encourage physically active lifestyles.

Bronfenbrenner (1979) developed an ecological approach, namely the Ecological Systems Theory (EST), as a holistic research methodology for understanding human development. Based on the EST, an individual is surrounded by different contextual factors within the overlapping layers of the ecological system, known as the microsystem, mesosystem, exosystem, macrosystem and chronosystem (Bronfenbrenner & Morris, 2006). The microsystem indicates the pattern of activity, social roles and interpersonal relations that a person experience. Beyond the microsystem, the mesosystem describes interrelations existing between two or more micro-settings. The exosystem and macrosystem delineate the larger social system and the values and beliefs of the culture, respectively. In nature, the structural network of interdependent contexts in the macrosystem evolves with time to form the chronosystem. It is possible that college students with different intrapersonal characteristics (e.g. self-efficacy and perceived enjoyment) interact with a variety of micro-environments (e.g. schools and homes) which in turn, are impacted by macro-environments (e.g. cultural, political and economic characteristics)(Deliens, Deforche, De Bourdeaudhuij, & Clarys, 2015).

2.6 Conclusions

Overall, this literature review shows that social supports from family and friends may be positively associated with engaging in physical activity in adults, and this relationship may be mediated by self-efficacy. Nevertheless, there is limited evidence in regard to this relationship among Chinese college students, nor the utilization of the EST in studying the correlates of physical activity. To bridge this research gap, this study will examine the interrelationships between social support, self-efficacy and physical activity in a Chinese college population. In applying EST to this study, the outcome variable and intrapersonal variables will be physical activity behavior and self-efficacy respectively, while the microsystems will be comprised two variables (i.e. social support from family and social support from friends). In the mesosystem, the interrelations between intrapersonal and microsystemic variables will be examined.

3. Methods

3.1 Samples

A convenience sample of 460 college students (254 men and 206 women) was recruited from two colleges in southern China. The sample size of 460 was determined by a Monte Carlo simulation study and chosen for a statistical power of 0.9 to detect the medium-sized effect of 0.42 (Muthén & Muthén, 2002). Although convenience samples are often used in psychological and management research and criticized for the generalizability of the findings (R. A. Peterson & Merunka, 2014), here students from different grades and majors were surveyed in an attempt for the results to be generalizable to other students with similar demographic characteristics in the surveyed colleges. When approached to solicit participation in the study, students who had physical and psychological limitations preventing them from engaging in physical activity were excluded from the study and asked to not take the survey. The printed self-administered questionnaires were distributed to participants in classrooms and cafeterias and were collected back after completion. The average time to complete the surveys was about 20 minutes. During the data collection process, 9 respondents filled in the same numbers on every question of the social support questionnaire, so they were eliminated as “flatliners” or “speeders” (resulting in 460 usable respondents). Two negatively-worded questions were embedded in the social support questionnaire such that if the students were reading carefully, they should have provided different answers comparing them with other items. Respondents who do not thoroughly read the questions and uses minimal cognitive effort to answer the questions may pose a threat to data quality (Smith, Roster, Golden, & Albaum, 2016). This project (19-027) was certified as exempt by the Institutional Review Board at the University of Idaho. Chinese versions of written informed consents were obtained by participants prior to the completion of the self-administered questionnaires. The English version of the informed consent was translated into Chinese and then back-translated to English as a means to confirm accuracy by bilingual professional.

3.2 Questionnaire

3.2.1 Demographic characteristics

The demographic information of participants was surveyed, consisting of sex (male and female), age, grade (freshman, sophomore and junior) and major in college.

3.2.2 Self-efficacy:

The Chinese version of the self-efficacy for exercise behavior change scale was used to measure participants' confidence in physical activity engagement (Marcus, Selby, Niaura, & Rossi, 1992). The questions asked were, "how confident you are that you could be physically active 1) when you are tired; 2) when you are in a bad mood; 3) when you feel you do not have time; 4) when you are on vacation; 5) when it is raining or snowing?". The students responded to a 5-point Likert scale from 1(not at all confident) to 5(extremely confident). A latent variable of self-efficacy was constructed using all 5 items. Internal consistency for this measure is 0.76 (Marcus et al., 1992).

3.2.3 Social support:

The Chinese version of the 13-item social support and exercise survey (SSES) was used to assess perceived support from family and friends regarding physical activity participation (Sallis, Grossman, Pinski, Patterson, & Nader, 1987). An example item from the SSES is, "during the past 3 months, my family (or members of my household) or friends gave me helpful reminders to exercise". We measured the support for physical activity from family and friends separately. Based on the results of the factor analysis in Sallis et al. (1987), the latent variable of social support from family was formed using 10 items: 1) exercised with me; 2) offered to exercise with me; 3) gave me helpful reminders to exercise; 4) gave me encouragement to stick with my exercise program; 5) changed their schedule so we could exercise together; 6) discussed exercise with me; 7) planned for exercise on recreational outings; 8) helped plan activities around my exercise; 9) asked me for ideas on how they can get more exercise; 10) talked about how much they like to exercise. On the other hand, the latent variable of friend support included 5 items: 1) exercised with me; 2) offered to exercise with me; 3) gave me helpful reminders to exercise; 4) gave me encouragement to stick with my exercise program; 5) changed their schedule so we could exercise together. Negatively-worded items (i.e., complained about the time I spend exercising; criticized me or made fun of me for exercising) were dropped to avoid a method bias (Lawman, Wilson, Van Horn, Resnicow, & Kitzman-Ulrich, 2011; M. S. Peterson, Lawman, Wilson, Fairchild, & Van Horn, 2013). The responses were administrated in a Likert format ranging from 1 (none) to 5 (very often), plus a “not applicable” option. Responses of “not applicable” were re-coded to 1 (none) on the assumption that respondents did not receive direct support from family or friends (Ball, Jeffery, Abbott, McNaughton, & Crawford, 2010). Cronbach’s alphas for measuring internal consistency range from 0.61 to 0.91 (Sallis et al., 1987).

3.2.4 Physical activity:

Self-reported physical activity in the last seven days was measured using the Chinese version of the Global Physical Activity Questionnaire (GPAQ)(Bull et al., 2009). The questionnaire asked participants how much time they spend performing moderate and vigorous activities for both activities at work and recreational activities and walking or bicycling for travel to get to and from places for at least ten minutes during the past week. The questionnaire also asked how many minutes participants spend sitting or reclining on a typical day. Moderate activities at work included carrying light loads, while recreational moderate activities include cycling, swimming, and volleyball. Work-related vigorous activities included heavy lifting, digging, aerobics or construction work, while recreational vigorous activities included, but not limited to, running and playing football. Travel to and from places indicated walking or bicycling for at least 10 minutes continuously to get to and from places. Sedentary behavior was defined as sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in a car, bus, train, reading, playing cards or watching television, but did not include time spent sleeping. Test-retest reliability was of moderate to substantial strength (Kappa 0.67 to 0.73; Spearman's rho 0.67 to 0.81) and concurrent validity between International Physical Activity Questionnaire (IPAQ) and GPAQ revealed a moderate to a strong positive relationship (0.45 to 0.65)(Bull et al., 2009).

MET was used to weight the intensity of the activity when calculating a student's energy expenditure in different activity domains. According to the GPAQ analysis guide (2006), moderate activities during working, traveling and leisure time are assigned a value of 4 METs; vigorous activities are assigned a value of 8 METs. The MET-hours per week for activity domains was calculated using MET multipliers as follows: 1) work MVPA (MET-hours/week) = 8.0 × total hours of work vigorous activity in a week + 4.0 × total hours of work moderate activity in a week; 2) recreational MVPA (MET-hours/week) = 8.0 × total hours of recreational vigorous activity in a week + 4.0 × total hours of recreational moderate activity in a week; 3) travel activity (MET-hours/week) = 4.0 × total hours of travel to and from places in a week. Subsequently, total physical activity (MET-hours/week) was calculated by summing the weekly MET-hours for each activity domains. In general, the WHO recommended at least 10 MET-hours/week of total activity (irrespective of domains) for health benefits (GPAQ Committee, 2006). Daily minutes for sedentary behavior, instead of their MET conversions, were used in further analysis.

3.3 Statistical analysis

Means and standard deviations of demographic characteristics of the participants were estimated before the model analysis. Group independence and mean differences of measured variables between male and female students were measured using Pearson's χ_2 test and t-test, respectively. The p-value of 0.05 was set as the criteria for detecting a significant difference. In the null hypothesis significant test, the p-value is defined as the probability of getting a result at least as extreme as that actually observed assuming the null hypothesis is true. Less than 0.1% of data were missing in the surveys, which were imputed using the predictive mean matching method (White, Royston, & Wood, 2011). The imputation was performed in R version 3.3.1 using the package "mice". Structural equation modeling with a two-step modeling approach (measurement model and structural model) was adopted to examine the hypothesized model (Anderson & Gerbing, 1988). Demographic variables (i.e., sex, age, grade, major) were integrated into the model as covariates. Modification indices were evaluated to assist in model selection. Given that the data did not meet the assumption of multivariate normality, bias-corrected bootstrap techniques with 5,000 resampling iterations were performed to obtain parameter estimates with 95% confidence intervals. The SEM analyses were performed using Mplus 8. The overall goodness of fit was assessed with multiple indices, including the Chi-square statistic (χ_2), comparative fit index (CFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) with its 90% confidence interval. CFI, SRMR, and RMSEA with respective values of greater than .90, less than .08, and less than .06 suggest a good model fit (L. Hu & Bentler, 1999).

4. Results

4.1 Sample characteristics

Table 4.1 shows the demographic characteristics of the sample. Of the 460 total participants, 206 (44.69%) were female, 198 (64.78%) were 18 or 19 years old, 119 (25.87%) studied high speed train majors and 298 (64.78%) were freshmen.

Table 4.2 presents the descriptive statistics of the variables of interest. Mean self-efficacy scores indicated that participants reported greater confidence in their ability to engage in physical activity "When I am on vacation" [M = 3.26 (SD = 1.24)] than in other situations. Moreover, men were more confident in performing physical activity "When I am tired" ($p < 0.001$) and "When I am in a bad mood" ($p = 0.024$) than women.

The average scores of the social support items suggested that students perceived social support more frequently for "Gave me helpful reminders to exercise" [3.36 (1.27)] and "Gave me encouragement to stick with my exercise program" [3.48 (1.28)] from their families, and "Exercised with me" [2.96 (1.06)] from friends than other items (i.e., scores of about 3 "A few times" and 4 "Often" on the 5-point Likert scale). Most of the social support items were not significantly different between male and female, except that on average male students perceived more frequently on "Complained about the time I spend exercising" and "Criticized me or made fun of me for exercising" from family than female students.

On average, students reported 11.81 (SD = 27.12) MET-hours/week for work-related physical activity and 18.56 (20.60) MET-hours/week for travel activity. The average recreational PA level for the participants was 25.59 (33.87) MET-hours/week, which accounted for 46% of total physical activity. Overall, 13% of participants did not meet the WHO recommendations of 10 MET-hours/week. Men engaged in more physical activity at work ($p = 0.012$) and during recreation ($p <$

0.001) times than women, while no sex difference was found for travel activity (p = 0.787). Lastly, female students on average engaged in more sedentary behavior than male students (p = 0.034).

Table 4.1: Descriptive statistics for the demographic variables.

Demographic variable	All (n=460)	Female (n=206)	Male (n=254)	*p* value
Age				NA[a]
17	11 (2.39%)	10 (4.85%)	1 (0.39%)	
18	160 (34.78%)	78 (37.86%)	82 (32.28%)	
19	138 (30.00%)	47 (22.82%)	91 (35.83%)	
20	102 (22.17%)	44 (21.36%)	58 (22.83%)	
21	36 (7.83%)	17 (8.25%)	19 (7.48%)	
22	13 (2.83%)	10 (4.85%)	3 (1.18%)	
Major				<0.001
Business	72 (15.65%)	21 (10.19%)	51 (20.08%)	
Engineering	80 (17.39%)	27 (13.11%)	53 (20.87%)	
Finance	93 (20.22%)	69 (33.50%)	24 (9.45%)	
High speed train	119 (25.87%)	32 (15.53%)	87 (34.25%)	
Management	96 (20.87%)	57 (27.67%)	39 (15.35%)	
Grade				<0.001
Freshman	298 (64.78%)	133 (64.56%)	165 (64.96%)	
Sophomore	79 (17.17%)	10 (4.85%)	69 (27.17%)	
Junior	83 (18.04%)	63 (30.58%)	20 (7.87%)	

Note: Count (percentage) are presented for the categorical variables and *p* values are calculated using the Pearson's χ^2 test. [a] Some categories had insufficient counts for performing the Pearson's χ^2 test.

Table 4.2: Descriptive statistics for the observed variables of interest.

	All (n=460)	Female (n=206)	Male (n=254)	*p* value
Self-efficacy				
When I am tired	2.22 (1.02)	2.03 (0.97)	2.38 (1.03)	<0.001
When I am in a bad mood	2.61 (1.14)	2.48 (1.11)	2.72 (1.16)	0.024
When I feel I don't have time	2.26 (1.04)	2.16 (0.96)	2.34 (1.09)	0.057
When I am on vacation	3.26 (1.24)	3.24 (1.24)	3.28 (1.25)	0.746
When it is raining or snowing	2.43 (1.22)	2.35 (1.17)	2.49 (1.25)	0.224

Social support from family				
Exercised with me	2.42 (1.04)	2.39 (0.98)	2.44 (1.09)	0.620
Offered to exercise with me	3.03 (1.31)	2.99 (1.32)	3.06 (1.30)	0.577
Gave me reminders	3.36 (1.27)	3.39 (1.23)	3.33 (1.30)	0.597
Gave me encouragement	3.48 (1.28)	3.37 (1.33)	3.57 (1.23)	0.101
Changed their schedule	2.12 (1.15)	2.08 (1.17)	2.16 (1.14)	0.462
Discussed exercise with me	2.58 (1.18)	2.53 (1.15)	2.62 (1.21)	0.420
Complained about exercise	1.45 (0.99)	1.24 (0.70)	1.61 (1.14)	<0.001
Criticized me for exercising	1.28 (0.89)	1.17 (0.70)	1.37 (1.02)	0.015
Gave me rewards for exercising	2.33 (1.32)	2.37 (1.31)	2.30 (1.32)	0.594
Planned for exercise on outings	2.46 (1.26)	2.49 (1.26)	2.43 (1.27)	0.606
Helped plan activities	2.33 (1.29)	2.27 (1.26)	2.39 (1.32)	0.345
Asked me for exercise ideas	2.11 (1.23)	2.03 (1.17)	2.17 (1.28)	0.238
Talked about they like to exercise	2.20 (1.23)	2.21 (1.24)	2.19 (1.22)	0.858
Social support from friends				
Exercised with me	2.96 (1.06)	2.90 (1.01)	3.01 (1.11)	0.270
Offered to exercise with me	2.81 (1.08)	2.74 (1.09)	2.86 (1.07)	0.254
Gave me reminders	2.65 (1.13)	2.71 (1.14)	2.60 (1.12)	0.295
Gave me encouragement	2.83 (1.25)	2.86 (1.24)	2.80 (1.25)	0.608
Changed their schedule	2.23 (1.19)	2.14 (1.10)	2.30 (1.24)	0.128
Discussed exercise with me	2.67 (1.18)	2.55 (1.09)	2.77 (1.25)	0.050
Complained about exercise	1.42 (0.97)	1.33 (0.82)	1.49 (1.07)	0.066
Criticized me for exercising	1.33 (0.91)	1.27 (0.82)	1.38 (0.99)	0.172
Gave me rewards for exercising	1.90 (1.18)	1.91 (1.15)	1.89 (1.21)	0.843
Planned for exercise on outings	2.15 (1.18)	2.20 (1.16)	2.11 (1.20)	0.443
Helped plan activities	1.99 (1.17)	2.01 (1.15)	1.97 (1.19)	0.707
Asked me for exercise ideas	2.15 (1.21)	2.14 (1.20)	2.17 (1.22)	0.796
Talked about they like to exercise	2.27 (1.26)	2.20 (1.23)	2.31 (1.29)	0.347
PA and sedentary behavior				
Work PA (MET-hrs/wk)	11.81 (27.12)	8.42 (21.79)	14.56 (30.54)	0.012
Travel PA (MET-hrs/wk)	18.56 (20.60)	18.84 (19.92)	18.32 (21.16)	0.787
Recreational PA (MET-hrs/wk)	25.59 (33.87)	19.61 (28.91)	30.44 (36.76)	<0.001
Total PA (MET-hrs/wk)	55.96 (57.67)	46.88 (53.37)	63.33 (60.03)	0.002
Sedentary behavior (hrs/day)	8.40 (3.20)	8.75 (3.22)	8.11 (3.17)	0.034

Note: PA = physical activity. Mean (standard deviation) are presented for the ordinal and continuous variables and *p* values are calculated using the independent t-test.

4.2 Measurement model

The measurement model was evaluated to confirm the factor structure of the latent variables. Twenty observed variables of self-efficacy and social support from family and friends were incorporated as observed variables of three corresponding latent variables. Other single item observed variables including total physical activity, physical activities in three different domains, sedentary behavior and covariates were not presented in the measurement model. Table 4.3 shows the model fitting results of initial and modified models. The fitting scores for the initial model indicated a poor fit to the data (CFI = 0.764). Examination of modification indexes suggested several adjustments to the correlated item errors in order to improve model fit. Specifically, the modified model allowed correlations of item errors between 1) "When I am in a bad mood" and "When it is raining or snowing" in self-efficacy items, and 2) "Gave me helpful reminders to exercise (family)" and "Gave me encouragement to stick with my exercise program (family)"; 3) "Planned for exercise on recreational outings (family)" and "Helped plan activities around my exercise (family)"; 4) "Asked me for ideas on how they can get more exercise (family)" and "Talked about how much they like to exercise (family)"; 5) "Offered to exercise with me (friends)" and "Gave me helpful reminders to exercise (friends)"; 6) "Gave me helpful reminders to exercise (friends)" and "Gave me encouragement to stick with my exercise program (friends)"; 7) "Gave me encouragement to stick with my exercise program (family)" and "Gave me encouragement to stick with my exercise program (friends)"; 8) "Changed their schedule so we could exercise together (family)" and "Changed their schedule so we could exercise together (friends)" in social support items. In terms of the first pair of correlated residuals, bad weathers such as raining and snowing may be correlated with a bad mood (Klimstra et al., 2011), which was not explained by the latent variable of self-efficacy. Apparent content overlap within latent factors revealed in the second to the sixth paired questions regarding social support, while the seventh and eighth pairs of correlated errors across latent variables may be explained by the fact that the social support questions were same for family and friends and surveyed back to back. Thus, the aforementioned correlated residuals seemed justifiable during the specification of the initial model (Byrne, 2013; Hooper, Coughlan, & Mullen, 2008). The modified model yielded an acceptable fit to the data (χ^2 = 375.893, *df* = 159, CFI = 0.914, RMSEA = 0.054, SRMR = 0.053) and was adopted in the analysis of the structural models. Standardized factor loadings of the items in latent variables are presented in Table 4.4.

Table 4.3: Goodness-of-fit indices of the measurement and structural models.

	χ^2	*df*	CFI	RMSEA (90% CI)	SRMR
Measurement model					
Initial model	760.978	167	0.764	0.088 (0.082, 0.094)	0.068
Modified model[a]	375.893	159	0.914	0.054 (0.047, 0.062)	0.053
Structural model one[b]					
Initial model	653.538	296	0.875	0.051 (0.046, 0.057)	0.089
Modified model[c]	520.434	218	0.906	0.055 (0.049, 0.061)	0.051
Structural model two[d]					
Initial model	699.616	330	0.877	0.049 (0.044, 0.054)	0.084
Modified model[c]	561.271	257	0.908	0.051 (0.045, 0.056)	0.049

Note: *df* = degrees of freedom; CFI = Confirmatory Fit Index; RMSEA = Root mean square error of approximation; CI = confidence interval; SRMR = Standardized root mean square residual. [a] The initial measurement model was modified by allowing residual correlations between specified items. [b] The hypothesized structural model one has total physical activity and sedentary behavior as outcome variables. [c] The initial structural model one was modified by deleting non-significant variables and paths. [d] The hypothesized structural model one has work, travel, recreational physical activity, and sedentary behavior as outcome variables.

Table 4.4: Standardized factor loadings for the items in the measurement model.

Variable	Factor loading[a]
Self-efficacy	
1. When I am tired	0.659
2. When I am in a bad mood	0.505
3. When I feel I don't have time	0.593
4. When I am on vacation	0.385
5. When it is raining or snowing	0.627
Social support from family	
6. Exercised with me	0.606
7. Offered to exercise with me	0.719
8. Gave me reminders	0.551
9. Gave me encouragement	0.575
10. Changed their schedule	0.651
11. Discussed exercise with me	0.665
12. Planned for exercise on outings	0.556
13. Helped plan activities	0.642
14. Asked me for exercise ideas	0.502
15. Talked about they like to exercise	0.548
Social support from friends	
16. Exercised with me	0.636
17. Offered to exercise with me	0.722
18. Gave me reminders	0.534
19. Gave me encouragement	0.594
20. Changed their schedule	0.669

Note: [a] Standardized factor loadings.

4.3 Structural models

The structural models were formed based upon the hypothesized model one using sedentary behavior and total PA as the dependent variable and model two using sedentary behavior, recreational PA, PA at work and travel PA as the dependent variables (Figures 1.1 and 1.2). Both structural models were acyclic with the exception that no causal path was presented between sedentary behavior and PA outcomes in the model. The non-significant paths were deleted from the models in favor of model parsimony. After the model modification, two structural models resulted in a good model fit (model one: χ^2 = 520.434, *df* = 218, CFI = 0.906, RMSEA = 0.055, SRMR = 0.051; model two: χ^2 = 561.271, *df* = 257, CFI = 0.908, RMSEA = 0.051, SRMR = 0.049). Standardized direct, indirect, and total effects with 95% bootstrap confidence intervals are shown in Table 4.5; the intervariable correlations of the structural model variables are shown in Table 4.6; the standardized path coefficients of modified structural model one and two are presented schematically in Figures 4.1 and 4.2, respectively.

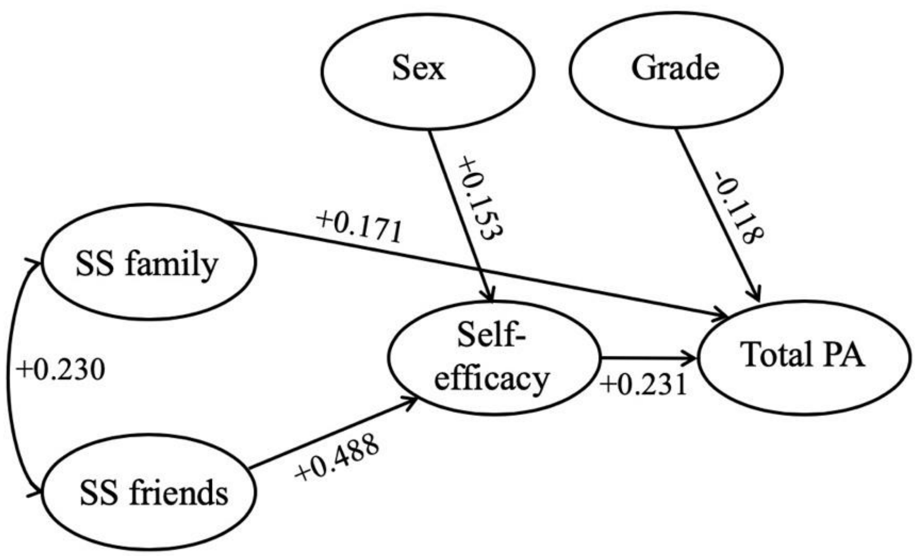

Figure 4.1: Structural model one with estimated path coefficients. SS = social support; PA = physical activity; covariates include sex, age, grade and academic major; the outcome variable is total PA; non-significant paths and variables were deleted from the model; estimated path coefficients are standardized.

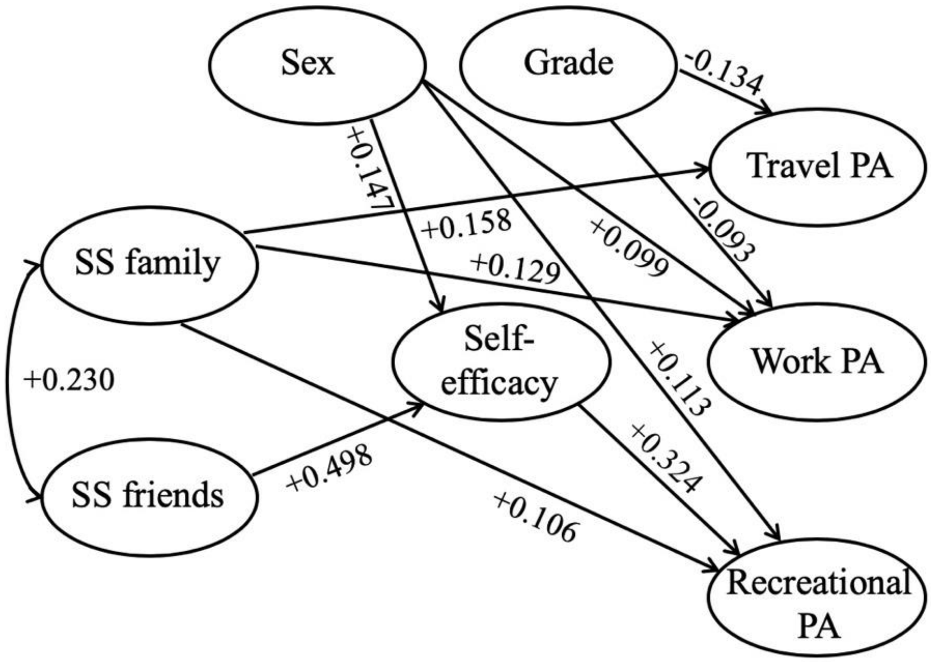

Figure 4.2: Structural model one with estimated path coefficients. SS = social support; PA = physical activity; the outcome variables are work PA, travel PA, and recreational PA; non-significant paths and variables were deleted from the model; estimated path coefficients are standardized.

Hypothesis 1 was partially supported by the results in two models. Specifically, social support from friends was positively associated with self-efficacy (model one: ß = 0.488; model two: ß = 0.498), whereas the association between social support from family and self-efficacy was not significant. Hypothesis 2 was tested using model one and was also partially confirmed by the findings that social support from family, but not from friends, was positively associated with respondents' total physical activity engagement (ß = 0.171). Furthermore, the results confirmed Hypothesis 3, that is, students who perceived a higher level of self-efficacy reported higher engagement of total physical activity (ß = 0.231). As for Hypothesis 4, the results suggested that the association between social support from friends and total physical activity was fully mediated by self-efficacy, and thus the indirect effect (ß = 0.113) equals to the total effect in this mediation relation. In contrast, self-efficacy did not mediate the relationship between family support and total physical activity, although higher family support directly predicted respondents' total physical activity engagement. Some covariates also posed an impact on the hypothesized models. Male students perceived higher self-efficacy than female (model one: ß = 0.153; model two: ß = 0.147) and students in higher grades participated in less total physical activity (ß = -0.118). Nevertheless, major and age did not influence the relationships in both models. Overall, model one accounted for a total of 11.9% of explained variance (R^2) in total physical activity.

Model two was constructed to evaluate the influences of social support and self-efficacy on physical activity breaking down in different domains. In regard to Hypothesis 5, social supports from family was positively associated with participation in recreational physical activity (ß = 0.106), work-related physical activity (ß = 0.129), and travel activity (ß = 0.158), respectively, while friend support was not directly related physical activities in all three domains. Given the results for Hypothesis 6 that self-efficacy was positively associated with participation in recreational physical activity (ß = 0.324), but not work-related physical activity and travel activity, Hypothesis 7 was partially supported such that self-efficacy fully mediated the relationships between social support from friends and participation in recreational physical activity ($ß_{\text{indirect effect}} = ß_{\text{total effect}} = 0.161$). Moreover, male students reported a higher level of recreational and work-related physical activities than female (ß = 0.113 and ß = 0.099, respectively), whereas students registered in the higher grade were engaged in less work-related and travel activities (ß = -0.093 and ß = -0.134, respectively). In summary, model two explained most of the variance in recreational physical activity (R^2 = 15.8%), in comparison with ones in work (R^2 = 3.8%) and travel activities (R^2 = 4.3%).

Table 4.5: Standardized direct, indirect, and total effects of variables and their 95% bias-corrected bootstrap confidence intervals in the structural model one and two.

Path	Structural model one		Structural model two	
	Estimate[a]	95% CI[b]	Estimate[a]	95% CI[b]
Direct effect				
FRIENDS → SE	0.488	(0.373, 0.588)	0.498	(0.383, 0.599)
SEX → SE[c]	0.153	(0.054, 0.248)	0.147	(0.047, 0.241)
FAMILY → TOPA	0.171	(0.072, 0.265)		
SE → TOPA	0.231	(0.108, 0.345)		
GRADE → TOPA[d]	-0.118	(-0.187, -0.042)		
FAMILY → RPA			0.106	(0.021, 0.188)
FAMILY → WPA			0.129	(0.039, 0.219)
FAMILY → TRPA			0.158	(0.059, 0.249)
SE → RPA			0.324	(0.229, 0.419)
SEX → RPA[c]			0.113	(0.029, 0.190)
SEX → WPA[c]			0.099	(0.010, 0.172)
GRADE → WPA[d]			-0.093	(-0.152, -0.026)
GRADE → TRPA[d]			-0.134	(-0.193, -0.066)
Indirect & total effect				
FRIENDS → TOPA				
Indirect effect	0.113	(0.052, 0.185)		
Total effect	0.113	(0.052, 0.185)		
FRIENDS → RPA				
Indirect effect			0.161	(0.105, 0.233)
Total effect			0.161	(0.105, 0.233)

Note: FAMILY = social support from family; FRIENDS = social support from friends; SE = self-efficacy; TOPA = total physical activity; WPA = work physical activity; TPA = travel physical activity; RPA = recreational physical activity. [a] Standardized path coefficient estimates for the structural models. [b] Bias-corrected bootstrap confidence interval. [c] Covariate path showing sex difference in the targeted variable. [d] Covariate path showing grade difference in the targeted variable.

Table 4.6: Correlations matrix of the structural model variables.

Variable[a]	1	2	3	4	5	6	7
1: Self-efficacy[b]	1.000						
2: Social support from family[b]	0.137	1.000					
3: Social support from friends[b]	0.433	0.001	1.000				
4: Work physical activity	0.083	0.140	-0.005	1.000			
5: Travel physical activity	0.037	0.160	-0.014	0.153	1.000		
6: Recreational physical activity	0.355	0.116	0.227	0.204	0.32	1.000	
7: Total physical activity	0.279	0.232	0.206	0.650	0.621	0.805	1.000

Note: [a] Covariates and non-significant variables are not included. [b] Variables are latent constructs.

5. Discussion

The present study incorporated demographical, intrapersonal and interpersonal components in the framework of EST to investigate the complex relationships between social support, self-efficacy and physical activity and to examine how self-efficacy may serve a mediational role in the relationships between social support from family and friends to total physical activity, work physical activity, travel physical activity, and recreational physical activity among Chinese college students, respectively. In our structural models, sex, grade, social support from family and friends, and self-efficacy were related to the amount of physical activity reported by college students.

As hypothesized, the results suggest that students who reported high self-efficacy scores participated in more physical activity (recreational and total activities), which provides additional support for the prior evidence that self-efficacy was an important and consistent correlate of physical activity in adults (Trost et al., 2002). This association is also compatible with previous findings among western (Hutchins et al., 2010; Wallace, Buckworth, Kirby, & Sherman, 2000) and Asian college students (D. Lee & Young, 2018; Xu et al., 2017). Although the literature shows limited evidence on this association among Chinese college students, Xu and colleagues (2017) found that Chinese college students who perceived high self-efficacy participated in more recreational physical activity. Rovniak et al. (2002) explained that self-efficacy led to greater use of self-regulatory strategies, which in turn exerted a larger effect on the participation of physical activity. Contrary to hypotheses, when we separated total physical activity to activities in different domains, self-efficacy predicted recreational physical activity, but not work-related and travel activities. This was expected as Bandura (1995) suggested that domain-specific self-efficacy may significantly influence an individual's behavioral choices in the corresponding domain. For example, a high perception of math self-efficacy increased the likelihood of choosing mathematics-related majors among college students, whereas occupational self-efficacy might influence ones' career choice (Bandura, 1995). In this study, the self-efficacy survey only specified the confidence level for performing the exercise in different situations and did not specifically target work-related and travel activities, which might attenuate the strength of the associations between self-efficacy and work-related and travel activities. To date, no study examining the associations between domain-specific self-efficacy and work and travel activities among Chinese college students was found in the exercise literature. Future studies ought to employ self-efficacy scales that target specific physical activity behaviors when examining the associations between self-efficacy and domain-specific physical activity.

The results from both structural models suggested that social support from family and friends had either a direct or indirect effect on physical activity behavior among Chinese college students. In general, these findings are similar to those of other studies (Leslie et al., 1999; Scarapicchia et al., 2017; Sylvia-Bobiak & Caldwell, 2006), but subtle differences in the results between these studies did emerge. In this study, higher perception of family support directly predicted higher total physical activity, whereas support from friends indirectly promoted total physical activity participation by mediating through self-efficacy. In contrast, Leslie et al. (1999) found that both family and friend social supports were important predictors of physical activity among Australian college students, More recently, a longitudinal study found that first-year Canadian college students engaged in higher amounts of physical activity when they perceived more social support from friends, but not support from family (Scarapicchia et al., 2017). Previous researchers also suggested that although both peer and family support had an indirect effect on leisure physical activity via self-efficacy, friends played a more influential role on perceived self-efficacy in comparison to family support (Sylvia-Bobiak & Caldwell, 2006). Nevertheless, the results of this study only confirmed the mediational relation of friends' support, and the relationship between family support and self-efficacy was not significant. This discrepancy may be due to the fact that the majority of college students in mainland China live in the dormitory on campus with school-mates, instead of living with their parents (Wang et al., 2009). Hence, friends would provide immediate support and play a vital role in enhancing ones' confidence to be physically active. On the other hand, the present findings showed that family support did not predict self-efficacy. Although family support might be an insufficient influence on students' self-efficacy, it was directly associated with physical activities in all three domains (i.e., work, travel, and recreational activity), which suggests that social support from family and friends might differentially affect physical activity engagement among this Chinese college population.

Although the relationships between social support from family and friends, self-efficacy and physical activity were confirmed, only a small proportion of the variance in physical activity ($R^2 <$ 20%) was explained by the examined social and cognitive factors. Other factors such as intention, self-motivation, expectation and stage of change may be important constructs in the behavioral mechanism of being physically active (Trost et al., 2002). By looking at a broader spectrum of predictors under the EST framework, we can construct a more complex model containing variables in the multilayer systems.

According to the EST, different factors in micro- and macro-systems may collectively determine individuals' behavioral choices (Bronfenbrenner & Morris, 2006). In the micro-system, the intangible environmental factors, such as intramural competitions, sports clubs, credit and non-credit exercise classes and other initiatives, have the potential to provide enjoyable and convenient physical activity opportunities, while the physical environment in the direct surroundings, including facility accessibility, availability of public transportation, pedestrian-friendly campuses and safe campus community may also positively shape physical activity behaviors among college students (Leslie, Sparling, & Owen, 2001). It is important to note that these environmental factors may interplay with psychosocial factors to influence physical activity behaviors (Owen, Leslie, Salmon, & Fotheringham, 2000). Therefore, understanding of how psychosocial and environmental factors play synergetic roles in the prediction of physical activity among Chinese college students are warranted in future research.

Although the line between hierarchical systems can be unclear, the overarching macro-system of cultural and economic patterns often poses distal influences directly or indirectly on a large population. Previous research in Australia found that small or medium-sized campuses in rural or lower socio-economic areas of large cities tended to have fewer and less well-equipped exercise facilities (Leslie et al., 2001), which may also be true in China. Additionally, culture and beliefs may interact with the relationships between variables in micro-system. For example, Korean college students may use social support less than American college students in taking time to engage in physical activity while maintaining a busy schedule, as Korean college students may worry whether asking for help made people feel uncomfortable (D. Lee & Young, 2018; Taylor et al., 2004). In the understudied Chinese college population, how macro-system factors moderate the complex relationships in the micro-system remain to be determined in future research.

This study also explored sex and grade differences of the hypothesized models. Male students had significantly higher scores for self-efficacy and recreational physical activity than female students, which is consistent with previous literature (Nehl et al., 2012; Sylvia-Bobiak & Caldwell, 2006). In addition, work and travel physical activity were more popular among junior than senior students, but no grade difference was found in recreational physical activity. Nevertheless, Wang, Xing, and Wu (2013) found that junior students were more capable than senior students in terms of physical activity behavior, probably because that seniors bore increasing workload and employment stress, and had less enthusiasm for different activities after few years of college life. Although more research is required to confirm these relationships, health educators ought to consider incorporating individual and cohort characteristics, such as sex and grade, into health interventions and target different students based on their characteristics.

This study provides insight into the physical activity behavior in different domains among Chinese college students by showing how social support and self-efficacy may predict work, travel, recreational and total physical activity. Although the college setting is generally considered supportive of an active lifestyle by offering recreational and sport opportunities and providing easy access to exercise facilities, there are still a large number of students that did not meet the recommended level of physical activity. Compared to young adults in general, college students under academic pressure are likely to spend a considerable amount of time and energy on their studies. Additionally, the availability of computers and the Internet offers additional entertainment options and reduce interest in exercise among college students (Wang et al., 2009). Although we acknowledge that further research is needed to verify the causal relationships in the examined models, the findings are informative for the development of physical activity promotion programs in Chinese college settings. Since self-efficacy, social support from family and friends, and other influential factors are potentially modifiable in educational environments, health intervention programs should be designed to provide a friendly environment for students who have relatively less confidence participating in physical activity. Next to that, the programs should adopt strategies that will provide opportunities for family members and friends to support physical activity behavior among college students and thus obtain mutual benefits of exercise for all participants.

Although the findings are informative for understanding the mechanisms influencing physical activity engagement among this Chinese college population, the present study has several limitations that warrant consideration. Firstly, due to the cross-sectional nature of the study design, it is impossible to rule out alternative explanations to the observed associations and the results do not allow for the causal interpretation. Utilizing the longitudinal models to examine these relationships would support the potential causal mechanism. Secondly, the use of a non-random convenience sample may raise a concern about the sample representativeness and lead to the response bias. Therefore, caution should be paid when generalizing to other college student populations. Future research to replicate our model using a larger, more representative college student sample is recommended to assess the reliability, validity and generalizability of our findings (R. A. Peterson & Merunka, 2014). Third, despite the fact that the psychosocial instruments (i.e., self-efficacy and social support from family and friends) were validated and had adequate internal consistency, their items do not target work and travel activities. To better understand how the hypothesized model explains the physical activity behavior in different domains, the surveys may need to be modified to include items targeting work and travel activities. In addition, the latent factor of social support was not specified on the types of support (i.e., instrumental, conditional, motivational and informational support) (Beets et al., 2010), which may be too general to explain these multidimensional features of social support and, lead to the unexpected correlations in the residuals. Finally, since self-reported instruments, such as the physical activity questionnaires, were utilized instead of more objective measures (such as accelerometers), recall bias likely occurred. Future research should consider integrating objective instruments when assessing physical activity behavior.

6. Conclusions

In summary, the results of this study help to clarify the relationships between social support from family and friends, self-efficacy and physical activity behavior in Chinese college students. In the examined Chinese college population, social support from friends posed a positive influence on recreational physical activity among students via increasing one's perception of self-efficacy to exercise. Support from family, on the other hand, predicted work, travel and recreational physical activity directly without meditating through self-efficacy. Moreover, male students engaged in more work and recreational physical activities than female students, while junior students were more capable of being physically active during working and traveling than seniors. Our findings provide guidance for the development of health interventions in the Chinese college population, suggesting that health educators should take these factors and personal characteristics into account as a useful combination when designing health programs to enhance physical activity. Future research should consider utilizing domain-specific instruments for measuring social support and self-efficacy, including micro- and macro-environmental variables in the ecological model.

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Appendix A - University of Idaho IRB Approval

University of Idaho
Office of Research Assurances

Institutional Review Board
875 Perimeter Drive, MS 3010
Moscow, ID 83844-3010
Phone: 208-885-6162
Fax: 208-885-6014
Email: irb@uidaho.edu

To:	David Paul
Cc:	Yazhuo Deng
From:	Jennifer Walker, IRB Coordinator
Approval Date:	February 05, 2019
Title:	The relationships between self-efficacy, social support and physical activity in Chinese college students
Project:	19-027
Certified:	Certified as exempt under category 2 at 45 CFR 46.104(d)(2).

On behalf of the Institutional Review Board at the University of Idaho, I am pleased to inform you that the protocol for this research project has been certified as exempt under the category listed above.

This certification is valid only for the study protocol as it was submitted. Studies certified as Exempt are not subject to continuing review and this certification does not expire. However, if changes are made to the study protocol, you must submit the changes through VERAS for review before implementing the changes. Amendments may include but are not limited to, changes in study population, study personnel, study instruments, consent documents, recruitment materials, sites of research, etc.

As Principal Investigator, you are responsible for ensuring compliance with all applicable FERPA regulations, University of Idaho policies, state and federal regulations. Every effort should be made to ensure that the project is conducted in a manner consistent with the three fundamental principles identified in the Belmont Report: respect for persons; beneficence; and justice. The Principal Investigator is responsible for ensuring that all study personnel have completed the online human subjects training requirement. Please complete the *Study Status Check and Closure Form* in VERAS when the project is completed.

You are required to timely notify the IRB if any unanticipated or adverse events occur during the study, if you experience and increased risk to the participants, or if you have participants withdraw or register complaints about the study.

Appendix B - Informed Consent form (English)

Informed consent

The relationships between self-efficacy, social support and physical activity in Chinese college students

Dear classmates,

You are invited to participate in a doctoral dissertation research study aimed at understanding psychosocial factors of physical activity among college students. Participation will take approximately 15 minutes and will involve completing the anonymous surveys. You will not be asked to provide any personally identifiable information within the survey, and there are no penalties or ramifications if you choose not to complete the surveys or to skip an item(s). This study has been approved by the Institutional Review Board in the University of Idaho.

Your answers to the surveys will increase our understanding of the associations between self-efficacy, social support and physical activity among college students.

By responding to the surveys, you are granting permission for the investigators to use your anonymous answers in our research.

If you have any questions regarding the procedures of the study, you may contact Yazhuo Deng at deng9578@vandals.uidaho.edu.

Thank you for your time!

Yazhuo Deng

Appendix C - Informed Consent form (Chinese)

知情同意书

中国大学生自我效能、社会支持和体力活动的关系

亲爱的同学们,

您被邀请参加一个旨在理解大学生体力活动的社会心理因素的博士论文研究。参与这个研究大约需要 15 分钟，并将填写完成一个匿名的问卷调查。您将不会被要求提供任何个人可识别信息，同时如果您选择不完成这个问卷或跳过某个问题也不会有任何处罚或后果。 这个研究项目获得了爱达荷大学机构审查委员会的批准。

您的问卷答案将增加我们对大学生自我效能、社会支持和体力活动之间关系的理解。

如果您回答问卷，您即授权研究人员在我们的研究中使用您的匿名答案。

如果您对本研究的程序有任何问题，请通过电子邮箱 deng9578@vandals.uidaho.edu 联系邓亚卓。

感谢您的宝贵时间!

邓亚卓

Appendix D - Questionnaire (English)

Survey for the relationships between social support, self-efficacy and physical activity among Chinese college students

Sex： female male

Age： ________________

Major： ________________

Grade： Freshman Sophomore Junior Senior

Global Physical Activity Questionnaire (GPAQ)

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Questions		Response	Code
Activity at work			
1	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work]* for at least 10 minutes continuously?	Yes 1 No 2 *If No, go to P 4*	P1
2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days └─┘	P2
3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P3 (a-b)
4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads]* for at least 10 minutes continuously?	Yes 1 No 2 *If No, go to P 7*	P4
5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days └─┘	P5
6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P6 (a-b)

Travel to and from places			
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship.			
7	Do you walk or use a bicycle (*pedal cycle*) for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If No, go to P 10*	P7
8	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days └─┘	P8
9	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P9 (a-b)

Recreational activities			
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure).			
10	Do you do any vigorous-intensity sports, fitness or recreational (*leisure*) activities that cause large increases in breathing or heart rate like [*running or football,]* for at least 10 minutes continuously?	Yes 1 No 2 *If No, go to P 13*	P10
11	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (*leisure*) activities?	Number of days └─┘	P11
12	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P12 (a-b)
13	Do you do any moderate-intensity sports, fitness or recreational *(leisure*) activities that causes a small increase in breathing or heart rate such as brisk walking, (*cycling, swimming, volleyball*) for at least 10 minutes continuously?	Yes 1 No 2 *If No, go to P16*	P13
14	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (*leisure*) activities?	Number of days └─┘	P14
15	How much time do you spend doing moderate-intensity sports, fitness or recreational (*leisure*) activities on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P15 (a-b)
Sedentary behavior			
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.			
16	How much time do you usually spend sitting or reclining on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs min s	P16 (a-b)

Confidence (self-efficacy) of Exercise Behavior Change

Physical activity or exercise includes activities such as walking briskly, jogging, bicycling, swimming or any other activity in which the exertion is at least as intense as these activities. Circle the number that indicates how confident you are that you could be physically active in each of the following situations:

Scale

1 = not at all confident ; 2 = slightly confident ; 3 = moderately confident ; 4 = very confident ; 5 = extremely confident.

1.	When I am tired	1	2	3	4	5
2.	When I am in a bad mood	1	2	3	4	5
3.	When I feel I don't have time	1	2	3	4	5
4.	When I am on vacation	1	2	3	4	5
5.	When it is raining or snowing	1	2	3	4	5

Social support and exercise survey

Below is a list of things people might do or say to someone who is trying to exercise regularly. Please rate each question twice. Under family, rate how often anyone living in your household has said or done what is described during the last three months. Under friends, rate how often you friends, acquaintances, classmates or coworkers have said or done what is described during the last three months. Please circle one number from the following rating scale in each space:

During the past three months, my family or friends:		none	rarely	a few times	often	very often	Does not apply
1.Exercised with me.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
2.Offered to exercise with me.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
3.Gave me helpful reminders to exercise	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
4.Gave me encouragement to stick with my exercise program	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
5.Changed their schedule so we could exercise together.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
6.Discussed exercise with me.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
7.Complained about the time I spend exercising.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
8.Criticized me or made fun of me for exercising.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
9.Gave me rewards for exercising	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
10.Planned for exercise on recreational outings.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
11.Helped plan activities around my exercise.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
12.asked me for ideas on how they can get more exercise.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0
13.Talked about how much they like to exercise.	Family	1	2	3	4	5	0
	Friend	1	2	3	4	5	0

Appendix E - Questionnaire (Chinese)

中国大学生自我效能、社会支持和体力活动的关系问卷

性别： 女 男

年龄： ______________

专业： ______________

年级： 大一 大二 大三 大四

体力活动			
下面我要询问你通常每周做各类体力活动所花费的时间。请回答下列问题（即使你认为自己不经常参加体力活动）。 首先谈到工作中的体力活动。工作是指你必须完成的有酬或无酬工作，**学习/培训**，家务，收割食物/粮食，渔业或猎捕食物，以及找工作。关于*剧烈活动*，是指高负荷的体力活动并引起呼吸心跳显著增加。*中等强度的活动*是指一定负荷的体力活动并引起呼吸心跳轻度增加。			
问题		**回答**	**代码**
工作时的体力活动			
1	你的工作需要做*剧烈活动*以致引起呼吸和心跳显著增加 [如搬运或举重物、挖掘或建筑工作] 时间至少持续 10 分钟吗？	是 1 否 2 *若为否，跳转至 P 4*	P1
2	你的工作中通常**每周**有多少天会做*剧烈活动*?	天数 └┘	P2
3	你通常**每天**工作中做多长时间的*剧烈活动*?	└┴┘ 小时 └┴┘ 分钟	P3 (a-b)
4	你的工作需要做引起呼吸和心跳轻度增加的*中等强度活动*，如快步走 [搬运较轻的物品] 时间至少持续 10 分钟吗？	是 1 否 2 *若为否，跳转至 P 7*	P4
5	你通常**每周**有多少天工作时做*中等强度的活动*?	天数 └┘	P5
6	你通常**每天**工作时做多长时间*中等强度的活动*?	└┴┘ 小时 └┴┘ 分钟	P6 (a-b)
交通时的体力活动			
以下问题不包括上述工作时的体力活动。 现在我要询问你通常的交通方式。例如，去上班（课）、去购物、去市场等 *[根据需要添加其他例子]*			
7	你去某个地方时步行或骑自行车至少持续 10 分钟以上吗？	是 1 否 2 *若为否，跳转至 P 10*	P7
8	你通常**每周**有多少天从一个地点到另一地点步行或骑自行车至少持续 10 分钟以上?	天数 └┘	P8
9	你通常**每天**在交通方面花多少时间步行或骑自行车？	└┴┘ 小时 └┴┘ 分钟	P9 (a-b)

娱乐性体力活动			
以下问题不包括上述的工作和交通过程中的体力活动。 现在我询问你有关运动、健身和娱乐性体力活动（休闲）的问题。			
10	你进行引起你呼吸和心跳显著增加的*剧烈的*运动、健身和娱乐性（休闲）体力活动并至少持续 10 分钟以上吗？	是 1 否 2 *若为否，转跳至 P13*	P10
11	你通常**每周**有多少天进行*剧烈的*运动、健身和娱乐性（休闲）体力活动?	天数 └┘	P11
12	你通常**每天**花多长时间进行*剧烈的*运动、健身和娱乐性体力活动？	└┴┘ 小时 └┴┘ 分钟	P12 (a-b)
13	你进行引起你呼吸和心跳轻度增加的*中等强度的*运动、健身和娱乐性体力活动（休闲），如快步走（骑自行车、游泳、排球）至少持续 10 分钟或以上吗？	是 1 否 2 *若为否，跳转至 P 16*	P13
14	你通常**每周**有多少天进行*中等强度的*运动、健身和娱乐性（休闲）体力活动?	天数 └┘	P14
15	你通常**每天**花多少时间进行*中等强度的*运动、健身和娱乐性（休闲）体力活动？	└┴┘ 小时 └┴┘ 分钟	P15 (a-b)

扩展内容：体力活动			
久坐习惯			
以下问题是关于工作时、在家里、交通过程中、会朋友时坐姿或靠着所花费的时间。 包括坐在桌前，与朋友一起坐着，乘坐轿车、公共汽车、火车，阅读，打扑克或看电视，但不包括睡觉的时间。			
16	你通常**每天**有多少时间坐着或靠着？	└┴┘ 小时 └┴┘ 分钟	P16 (a-b)

身体活动/体育锻炼信心量表

“身体活动/体育锻炼”包括例如快步走、慢跑、骑车、游泳或者其他强度类似于此的活动。请圈出在表示你有信心在下列情况中积极锻炼的数字。

程度

1 = 完全没信心； 2 = 一点点信心； 3 = 一般； 4 = 很有信心； 5 = 极其有信心

1. 当我疲倦的时候	1	2	3	4	5
2. 当我心情不好的时候	1	2	3	4	5
3. 当我觉得没时间的时候	1	2	3	4	5
4. 当我在度假的时候	1	2	3	4	5
5. 下雨或者下雪的时候	1	2	3	4	5

身体活动社会支持量表

*中等强度身体活动*的种类包括：快走、爬坡、上楼梯、打太极拳、太极剑、跳舞、游泳、羽毛球、跳绳等活动。你的*家人或朋友*会影响到你坚持定期做*中等强度的身体活动*。请问：*在过去 3 个月*，*你的家人或朋友*说过或者一起做过以下事情吗？频率如何？请在*家庭和朋友*栏代表的相应频度的数字的上画圈。如果你没做过以上的活动，请圈 0 = 不适用。

你的家人或者朋友与你说过或一起做过以下事情的频度有多大？		从未	很少	有时	经常	总是	不适用
1. 同我一起做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
2. 提议同我一起做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
3. 提醒我做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
4. 鼓励我坚持做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
5. 改变他们的行程或时间，使我们可以一起做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
6. 与我一起讨论做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
7. 抱怨我把时间花在做身体活动上	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
8. 批评或耻笑我做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
9. 奖励我做身体活动（例如给我喜欢的东西）	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
10. 外出娱乐时，安排我做身体活动的内容	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
11. 帮我安排我的身体活动内容	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
12. 询问我，他们如何才能变得更积极地去做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0
13. 同我讨论他们多么喜欢做身体活动	家人	1	2	3	4	5	0
	朋友	1	2	3	4	5	0

调查结束，谢谢您的作答！