Relating Chinese University Administrators' Physical Activity Levels to Self-Rated Health and BMI

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Abstract

The study aimed to explore Chinese university administrators' physical activity (PA) levels and its relationships to self-rated health and body mass index (BMI). A pre-validated survey was used to collect the data. In total, 443 participants took part in the study. The percentages of participants meeting the recommended PA and BMI were calculated. MANOVA was performed to analyze the PA differences in age and gender, and BMI and self-rated health, respectively. It was found that 75.2% of the participants did not meet the recommended PA and 43.8% of them were overweight and/or obese. Self-rated health was a significant factor influencing their light PA only. No gender differences in PA were found, however. The data from the study suggested that there was an urgent need to promote healthy lifestyles among Chinese university administrators by increasing their PA levels and reducing the prevalence of weight problems.

Keywords: University administrators, exercise patterns, self-reported health

Introduction

It has been well documented that engaging in physical activity (PA) on a regular basis is one of the most important health-related behaviors known to contribute to numerous positive health outcomes (US Dept. of Health and Human Service [USDHHS], 2008). Physical inactivity, however, has penetrated into all groups, regardless of gender, age, ethnicity, and nationality, insulting in the increased risks for poor health in recent years (Kohl II et al., 2012). As the costs of treating health problems caused by a sedentary lifestyle continue to rise, finding effective approaches to increase PA in the general population can result in great health and economic benefits (Humphreys, McLeod, & Ruseski, 2014).

A number of studies have been conducted to understand PA effects on health (Carter & Kelly, 2013; Grant & Baker, 2017; Janssen & LeBlanc, 2010). The quantity and types of PA are found to determine what health benefits can be accrued (Humphreys et al., 2014; USDHHS, 2008). Both PA and health, however, are complex and cannot be easily and accurately measured. For example, PA with different intensities cannot simply be summed as vigorous PA produces much more health benefits than that with low intensity when the duration of PA is the same. Furthermore, the types of PA (i.e., aerobic vs. strength) produce different health benefits (USDHHS, 2008; World Health Organization [WHO], 2010). Regarding health benefits of PA, it is both physical and psychological (Grant & Baker, 2017; Lassenius, Åkerlind, Wiklund-Gustin, Arman, & SÖderlund, 2013), which are difficult to assess. Overall, all the above factors add further complexity to accurately investigate PA and health. This may have hindered our endeavor to investigate PA and health.

PA MET values are commonly used to unify measurements of PA with different intensity (Ainsworth et al., 2011). A common practice is that vigorous PA (VPA), moderate PA (MPA), and light PA (LPA) are quantified by the formula: weekly times of VPA, MPA, and LPA multiplying 9, 5, and 3, respectively, so that PA can be summed (Keating et al., 2005b). Furthermore, there have been attempts to issue recommended PA to guide individuals' PA behaviors. Although the recommendations for PA have been revised and issued by different institutes over the past three decades (i.e., Centers for Disease Control and Prevention, 2005; USDHHS, 2008; WHO, 2010), the current guidance for adults in the US and WHO were similar in terms of PA quantity and types. Specifically, the American one is that adults should accumulate "a minimum of 30 minutes of PA of moderate intensity on most, if not all, days of the week." (USDHHS, 2008). In addition, 2-3 times weekly strength exercise were also recommended. In spite of differences in wording, converting into MET value of PA, the current consensus on the PA guidance is that every adult needs accumulate 30 METs ·h/wk. of PA, including 2-3 times of strength PA per week, to prevent chronic diseases and to obtain numerous health benefits. While using different wording without specific quantity and types of PA, the general administration of Sport of China (2008) also issued an important call for promoting PA in China.

Because of the issued PA guidelines for maintaining sound health (USDHHS, 2008; WHO, 2010), identifying the percentage of individuals meeting the PA guidelines has caught the attention of professionals in the fields related to preventive medicine (Anokye, Pokhrel, Buxton, & Fox-Rushby, 2013; Blair et al., 2008; Carlson, Fulton, Schoenborn, & Loustalot, 2010; Deng, Castelli, Castro-Pinero, & Guan, 2011; Perry, Saelens, & Thompson, 2011). Examining an American adult sample, Carlson and colleagues (2010) have noted that slightly less than half of US adults (i.e., 43.5%) were aerobically active while a little more than a quarter (i.e., 28.4%) were highly active and about one fifth (i.e., 21.9%) met the muscle-strengthening guideline. There were only 18.2% of US adults meeting both aerobic and muscle-strengthening PA guidelines. More alarmingly, the authors found that no changes have been made in increasing PA levels in the U.S from 1998 to

2008. To the best of our knowledge, no previous research on the topic using Chinese samples has been reported in the literature. Overall, this line of research is understudied and many basic research questions concerning this topic remain unanswered.

The methodologies used for collecting PA data in previous research need to be addressed in order to help readers understand administrators' PA patterns. A careful examination of literature on the topic suggested that various PA collection methods have been available such as pedometers (Dauenhauer & Keating, 2011), accelerometers (Burg et al., 2017; Rote, 2017; Troiano et al., 2008), and self-reported PA surveys (Corder et al., 2009; Murphy, 2017). Although pedometers and accelerometers can measure PA levels more objectively (Troiano et al., 2008), survey/questionnaire method has been widely used due to its low cost and feasibility for large samples (Blair et al., 2008; Carter & Kelly, 2013; Furtado, Lieberman, & Gutierrez, 2018; Keating et al., 2014). Among many available PA surveys/questionnaires, the weekly leisure-time exercise questionnaire (LTEQ) developed by Godin and Shephard (1985) was among the widely used ones in various populations in many countries (Amireault, Godin, Lacombe, & Sabiston, 2015; Cholewa & Irwin, 2008; Johnston, Barkyoumb, & Schumacher, 2014). It has also been translated in Chinese and used in Chinese settings by Keating and colleagues (2005b). The questionnaire records internationally performed exercises in similar forms, such as basketball, volleyball, fast walking, jogging, etc. In addition, it can provide data of weekly exercise events at different intensity levels (i.e., mild/light, moderate, and vigorous). The reliability and validity of the questionnaire have been demonstrated in many studies from different countries (Amireault et al., 2015; Keating et al., 2005b).

As noted earlier, the assessment of general health is also complex. Self-rated /reported general health measure has been commonly used among healthy adults as a valid independent predictor of over health without using specific biomedical indicators and mortality correlates (Blair et al., 2008; Carter & Kelly, 2013; Faught, Gleddie, Storey, Davison, & Veugelers, 2017; Limm et al., 2011; Schuring, Mackenbach, Voorham, & Burdorf, 2011). Although it is not the same as the medical ones, self-rated health is deemed as a valid and reliable indicator of health, regardless of countries, populations, and ethnicities (Norman & Bambra, 2007). To date, self-rated health using a Likert-scale has been used in a number of studies to provide valid information concerning individual's overall health (Keating et al., 2014; Limm et al., 2011; Prosper et al., 2009; Schuring et al, 2011). Evidence regarding the relationship of PA and perceived health has been consistent, even though there is limited research on the topic. Overall, studies have found that those who perceived their general health "excellent" performed significantly more PA among university students (Lolokote, Hidru, Xiaofeng Li, & Li, 2017) and older adults (Blair et al., 2008). However, no studies involving university administrators on PA and perceived health have been available.

Besides studies on PA and Health, BMI and perceived health have also been explored (Carter & Kelly, 2013; Deng et al., 2011; Keating et al., 2014; Orpana et al., 2010; Prosper et al., 2009). Similar to that for PA, there are also recommended cut-off values for underweight (BMI <18.5), normal weight (BMI >18.5 & <25), overweight (BMI >25 & <30) and obese (BMI > 30) (WHO, 2004). It is necessary to point out the aforementioned cut-off values have remained the same for more than a decade, even though it has been suggested that these values are inappropriate for Asians (Deurenberg-Yap & Deurenberg, 2003; Zeng et al., 2014). Lower cut-off BMI values (i.e., BMI < 23.5 - 24 for the acceptable weight, and 27.5 for obese) should be used for Asians (Cheong et al., 2012; Deurenberg-Yap & Deurenberg, 2003). On the other hand, using lower cut-off values for BMI in Asian populations, previous research on the topic indicated that the higher the BMI and the lower self-rated health (Imai et al., 2008; Prosper et al., 2009). In addition, it was found that the lower BMI cut-off values could be used to predict diabetes, hypertension, and hypercholesterolaemia (Cheong et al., 2012; Zeng et al., 2014).

Previous research has indicated that occupations have an effect on individuals' PA level and specific research targeting at different occupations is needed to effectively promote PA (Lassenius et al., 2013; Limm et al., 2012). University administrators' PA warrants the attention of professionals in preventive medicine considering that university administrators are essential to the operation of any institutions in higher education (Gentry, Katz, & McKeeters, 2009). As decision and policy makers, administrators play a critical role in PA promotion on campus (Linnan, Weiner, Graham, & Emmons, 2007). Physically active administrators may be more supportive to combat sedentary lifestyles in higher education. Unfortunately, there is not a robust field of investigation into managerial factors concerning PA promotion on campus (Byrne et al., 2011; Milroy, Wyrick, Bibeau, Strack, & Davis, 2012; Yuan, Lv, & VanderWeele, 2013), even though building healthy campuses is of concern (DeClercq, 2016). To date, our knowledge about this matter is very limited. It still remains unclear what university administrators' PA levels are and if their PA levels are correlated with their support of PA promotion.

The lack of research related to university administrators and their PA is surprising given its potential influences on all individuals' health in higher education. Moreover, unlike many other settings, university campuses share many commonalities such as policy making procedures, physical structures, the personnel characteristics, and formats for course scheduling (Keating et al., 2014; Shangguan et al., 2017). The aforementioned common characteristics can generate a much higher generalizability of research findings than those in other settings, saving millions of dollars in combating health problems resulted from the lack of PA. Therefore, there is an urgent need to enrich our knowledge about administrators' PA and their role in PA promotion on campus.

As the first step to begin the endeavor of understanding educational administrators' PA and its relationship to health in China, the purposes of the current study were threefold: (a) to explore administrators' overall PA patterns and BMI in comparison with the recommended cut-off values; (b) to examine PA differences by self-rated health and BMI; and (c) to test PA differences by age and gender. Regarding to the first research question, it was hypothesized that university administrator PA level was lower than the recommended amount PA while the majority of participants were classified as having a weight problem. For the second question, the hypothesis was that those who perceived their general health "excellent" with desired weight had the highest amount of MVPA while no LPA differences existed. In regard to

the last question, it was hypothesized that younger males had more MVPA than other groups. Our study would provide baseline data for further investigation on the topic and add new understanding about the PA patterns and its relationships to perceived general health and BMI of university administrators who are essential to decision making in higher education. It is hoped that the current study would stimulate more research on the topic in the future.

Method

Due to the fact that the data were already collected without any personal information, an IRB approval for using existing data was granted by the university affiliated with the senior author. Data analyses were completed after the IRB approval was obtained.

Participants

University administrators in China were contacted by email, by phone, and/or in person based on the information posted on the university websites. Employment title data (i.e., president, vice president, dean, vice dean, director of centers, vice director, department head, vice department head, and other officers) were collected to ensure the eligibility of participants. Among 474 returned surveys, 443 were usable. The average age was 47.83 (SD = 5.32). There were 83.3% of male, which was representative sample of the administrator population in which males hold the majority of the administrative positions in higher education in China. Refer to Table1 for detailed demographic information.

Table 1. *Participants' demographic information*

Category		M(SD)	N(%)
Age	47.8(5.3)		
	=<45		150(33.9)
	46-50		178(40.2)
	>=51		115(26.0)
Sex	Male		369(83.3)
	Female		74(16.7)
BMI	Desired weight		249(56.2)
	Overweight/obese		194(43.8)
Self-rate health	Poor		100(22.6)
	Good		265(59.8)
	Very good		78(17.6)
PA	MVPA_MET	13.4(12.9)	
	LPA_MET	7.8(7.4)	
	TPA_MET	21.3(14.6)	

Note: MVPA_MET=moderate and vigorous physical activities in MET values; TPA_MET=total physical activity in MET values

Measures

Base on the purposes of the study, the following three types of measures were included in the study: demographic data, perceived general health and BMI, and PA data. All the data were self-reported. Both numeric and categorical variables were used according to the purposes of the study.

Demographic data. The most commonly tested demographic variables were chosen. Specifically, participants were asked to report age, gender, height (in centimeters), and weight (in kilograms). Participants were also asked to check their administrative position at the time when the survey was completed. This question was used as the filter for ensuring the eligibility for participation.

Self-rated health and BMI. Participants were asked to rank their general health using a 5-point Likert-scale measuring ordinal levels (i.e., 1 to 5) of health from poor to excellent. Due to the small sample sizes in two categories, the "poor and fair" groups were combined as "poor" while "very good and excellent" grouped were put together as the "very good" group. Thus, there were three groups in perceived general health: poor, good, and very good.

BMI was then calculated using the following formula recommended by WHO (2004): BMI = weight (kg)/height $(m)^2$. The numeric BMI measure was originally converted into a categorical variable using the widely acceptable criteria: desired weight (BMI<25); overweight (25<=BMI<=30); and obese (BMI>30). Because of the small size of the obese group (less than 1%), the obese group was combined with the overweight group, resulting two groups for BMI - desired weight and overweight groups.

PA variables. The PA data were measured using the Chinese version of LTEQ. Based on the recently revised PA recommendations for adults (USDHHS, 2008), the duration of exercise in each intensity category was changed from 15 min. to 30 min. to be in line with the most recent PA cut-off values for maintaining good health. Specifically, participants were asked: "During the last 7 days, how many times did you do light/moderate/vigorous PA in your leisure time for at least 30 minutes?" Two independent PA variables were created: moderate and vigorous PA (MVPA) (i.e., Times of Moderate PA*5 + Times of Vigorous PA*9), and light PA (LPA) (i.e., Times of Light PA*3). The total PA (TPA) was the sum of MVPA and LPA.

Data collection

A paper-based survey was distributed by our Chinese colleagues throughout a four-month period. An individual from each university was contacted and asked to distribute the questionnaires to potential participants. Responses were collected by the same individual and then sent back to our primary contacts in China. All information was entered into an electronic spreadsheet by the senior author and double checked for accuracy by the other authors.

Data analyses

Data screening was first conducted. Cases with more than 50% missing values were deleted (Mayers, Gamst, & Guarino, 2016). Age was recoded as a categorical variable for MANOVA. Three age groups (i.e., young < 45, 45=<middle age<=55, and old > 55) were used to create a similar sample size for each group. Descriptive analyses were performed, followed by the assumption check for MANOVA. The cut-off value for meeting the recommended amount of PA was set at 30 MET, which is equal to have 6 times of moderate PA weekly (USDHHS, 2008; WHO, 2010) while BMI <24 was the criterion for desired weight (Cheong

et al., 2012; Zeng et al., 2014). The percentages of individuals meeting the above cut-off values were calculated and chi-square test was employed to examine the significant differences between the met and unmet groups. The correlations between BMI and PA with different intensities were then calculated. A 3 (i.e., perceived general health) X 2 (i.e., BMI) two-way factorial MANOVA was employed to examine MVPA and LPA differences in Self-rated health and BMI, which was the second research question. To answer the third research question, age and gender differences in MVPA and LPA were also tested using MANOVA. According to Mayers and colleagues (Mayers et al., 2012), TPA was not used in MANOVA because it was a combined variable. All analyses were done using SPSS version 20. Significance level was set at *p* value at < .05.

Results

Meeting recommended PA and BMI

For the overall present study sample, only 24.8% and 56.2% of participants had more than 30 MET and desired weight, respectively, suggesting that less percentage of participants met the recommended amount of PA than that for BMI. When age, gender, and self-rated health were considered, no PA differences in age and self-rated health were found. Gender, however, had a significant difference in meeting recommended BMI, with males having a higher percentage of individuals in the overweight group (see Table2). The correlations between BMI, MVPA, and TPA were significant but low (r_{MVPA}= .1, p < .05; r_{TPA}= .1, p < .001). No significant correlation between LPA and BMI was found.

Table 2. *Percentages of meeting recommended PA and BMI guidelines*

Variables	PA		BMI	
	Met n(%)	Not Met n(%)	Met n(%)	Not Met n(%)
Overall				
	110(24.2)	333(75.8)	249(56.2)	194(43.8)
Gender				
Male	93(17.1)	276(82.9)	187(50.7)**	182(49.3)
Female	17(23.0)	57(77.0)	62(83.8)**	12(16.2)
Age				
=<45	39(26.0)	111(74.0)	87(58.0)	63(42.0)
46-50	49(27.4)	129(72.6)	105(59.0)	73(41.0)
>=51	22(19.1)	93(80.9)	57(49.6)	58(40.4)
Self-rated health				
Poor	27(27.0)	73(73.0)	60(60.0)	40(40.0)
Good	74(27.9)	191(72.1)	146(55.1)	119(44.9)
Very good	9(19.5)	69(88.5)	43(55.1)	35(44.9)

Note: ** = *P* <.01

Differences of MVPA and LPA in perceived general health and BMI

MANOVA test revealed significant a main effect of perceived health [Wilk's lambda = .91, $F_{(4, 436)}$ = 10.1, p <.01, eta squared =.04] while BMI main effect was not significant. The interaction of perceived general health and BMI, however, was significant [Wilk's Lambda = .98, $F_{(4, 872)}$ = 2.4, p <.01, eta squared =.01]. The post hoc test indicated that the difference existed in LPA by perceived general health [$F_{(2, 443)}$ = 18.7, p < .01, partial eta squared = .08]. Perceived general health and BMI interaction difference was caused by the MVPA [$F_{(2, 443)}$ = 2.9, p < .05, partial eta squared = .01] (see Table 3).

Table 3. *The means and standard deviations of MVPA and LPA by self-rated health, BMI, age and gender*

Variable	MVPA	LPA
	Mean(SD)	Mean(SD)
Gender		
Female	13.1(9.7)	8.6(8.4)
Male	13.4(13.4)	7.7(7.2)
Age		
45<	12.9(12.1)	8.6(8.1)
45=<>=55	14.8(14.0)	7.3(7.1)
>56	8.3(7.9)	8.0(6.9)
Self-rated health		
Poor	12.5(11.0)	8.3(6.8)**
Good	14.1(14.5)	9.0(7.5)**
Very good	11.9(8.3)	3.4(6.3)**
BMI		
Desired weight	12.3(12.3)	7.4(7.7)
Overweight	14.8(13.5)	8.5(7.1)
Interaction of general health & BMI		
Desired weight		
Poor health	10.3(10.0)	7.0(7.0)
Good health	12.8(13.7)	8.8(8.0)
Very good health	13.5(9.7)	3.2(6.4)
Overweight		
Poor health	15.9(10.0)*	10.4(5.9)
Good health	15.8(15.3)*	9.2(7.0)
Very good health	10.0(5.8)*	3.7(6.7)

Note: * = *P* <.05; ** = *P* < .01

Differences of MVPA and LPA in age and gender

Age and gender differences in MVPA and LPA were not found as the MANOVA test was not significant. Neither was the interaction between the two variables. Refer to Table 3 for detailed data regarding MVPA and LPA by age and gender.

Discussion

Numerous studies have suggested that higher education is an important setting for PA promotion. The focus to date, however, has been students (e.g., Cholewa & Irwin, 2008; Shangguan et al., 2017). The current study takes a step further by exploring university administrators' PA and its relationships to self-rated health and BMI. The results of the study would not only help us better understand administrators' PA, but also provide a basis for further examining administrators' PA behaviors and their support of PA promotion on campus. The highlights of the results were threefold: (a) only about one quarter of the participants met the recommended PA guidelines; (b) less % of participants met the recommended amount of PA than that for BMI; and (c) gender was a factor influencing administrators' BMI. Although the present study sheds some light on administrators' PA level and its relationships to self-rated health and BMI, our knowledge about this topic remains limited and thus it warrants further study.

To our knowledge, the current study is the first attempt to explore Chinese university administrators' PA. Because previous studies on the topic were unavailable, it is unclear whether university administrators' PA has been improved. By the same token, it is difficult to examine changes of BMI. Moreover, noticeably, the percentage of maintaining desired weight was higher than that for PA. The result of the current study supported the hypothesis that the percentages of administrators meeting PA and BMI guidelines were both low. Furthermore, the data from the study indicated the need for examining both PA and BMI as many individuals may be misclassified as healthy if only BMI was considered. Research (USDHHS, 2008; WHO, 2010) has indicated that a sedentary lifestyle may lead to many health problems. The low percentages of meeting the recommended PA and BMI are a cause of concern. Effective interventions are urgently needed to increase the PA levels and reduce BMI involving this population.

While the current study did find a significant main effect of self-rated health on PA, surprisingly, the result was the opposite of what has been found in the literature that those who rated their overall health "very good" demonstrated a significant higher level of PA (Deng et al., 2011; Imai et al., 2008; Prosper et al., 2009). One possible explanation could be that those who perceived better health, having been satisfied with their health status, did not take exercise as a priority in their life thus reported lower level of PA. Moreover, it was worth noting the difference lay in LPA instead of MVPA, which was also not in line with what was reported in a study involving university students (Keating et al., 2014). Because the participants in the current study were much older than these studied by Keating and colleagues (2014) and MVPA declines as age increases (Ng, Norton and Popkin, 2009), the data from the study may enforce the contention that PA patterns and levels vary by age. The discordance between perceived general health and PA merits more research in the future.

The relationship between BMI and PA has been examined extensively and it has been found that BMI is negatively correlated to PA and/or MVPA (Carlson et al., 2010). Unexpectedly, the current study found that the correlation between the above two variables was positive, even though the correlation was small. There are two plausible explanations. First, it may be related to the argument (Deurenberg-Yap & Deurenberg, 2003) that WHO's (2004) BMI cut-off values may need to be re-valued when Asian populations are examined. The false classification of BMI among Asian populations may have resulted in the contradictory finding. The second possible explanation might be that those with weight problems may have realized the problem and decided to exercise more. This result was similar to the aforementioned finding of negative relationship of self-rated health on PA. However, caution needs to be exercised when interpreting the result found by the current study given the magnitude of the correlation was very low. More robust research studies investigating PA and BMI would be particularly useful to confirm the finding.

The data from the current study suggested that males need more interventions than females concerning their weight management as there was a significant higher percentage of males in the overweight group, even though PA differences in gender were not significant. Similar to the trend happening in white collar work forces in the states (Kirk & Rhodes, 2011), Chinese university administrators' standard workloads consist of longer weekly hours (e.g., 50 hours/week) and weekend work with a lack of routine, resulting in irregular time slots for PA (Monda, Gordon-Larsen, Stevens, & Popkin, 2006). Therefore, it is difficult to implement PA interventions in groups. Individuality must be taken into consideration when designing PA intervention programs to fit their irregular and hectic schedule.

Age seemed to be consistent correlate of attaining the PA recommendation in adults and a negative correlation of PA and age has been found (Carlson et al., 2010; Shibata, Oka, Nakamura, & Muraoka, 2009). The result of the current study, however, was not in line with those reported in the literature as no age differences were found. One of the possible reasons might be that the majority of participants were in the middle age range (i.e., 40-55), yielding very limited age variations. However, the sample is a representative of its population because most individuals cannot be promoted to be administrators until reaching their middle age in higher education in China. Hence, the insignificant age difference in PA might be conceivable.

Gender difference in PA has been commonly explored in the literature (Lassenius et al., 2013; Lawler, Heary, & Nixon, 2017; Keating et al., 2014). Previous research on PA and gender has generated contradictory results. Specifically, some studies found that males involved in more PA than their female counterparts (Deng et al., 2011; Keating et al., 2005a; Lawler et al., 2017) while others found the opposite results or no differences (Kirk & Rhodes, 2011). It is important to note that the non-difference of PA in gender may be related to the characteristics of the sample given that participants were all middle aged educational administrators. This may suggest that they all performed similar daily routines without different family duties such as cooking or taking care of young children. Due to the cross-sectional nature of the study, unfortunately, sound conclusion about PA differences in gender cannot be drawn. More experimental research is needed in the future.

Limitations and Conclusions

There are limitations that should be noted. First, all data were derived from self-reports of survey participants. Self-reporting bias has been found to result in overly high estimates of PA. Second,

this was a cross-sectional survey and causality conclusions could not be drawn. Experimental studies would provide additional insight. Finally, there was the lack of information regarding strength exercise data, resulting in incomplete assessment of PA using the recommended PA guidelines for adults.

In conclusion, the current study marks the first attempt to investigate Chinese university administrators' PA and its relationship to self-rated health and BMI. Given that administrators' own PA level may be associated with their decisions on PA promotion for students and employees in higher education, this line of research warrants more attention of PA professionals in the future. The low percentage of participants meeting PA guidelines calls for immediate interventions involving this population as sedentary lifestyles lead to a higher risk for poor health. Furthermore, both PA and BMI need to be taken into consideration when assessing individuals' potential health risks.

Recommendations for future research

Future research should further explore what underlies the concept of self-rated health and its relationships to PA and BMI. Studies on effectively promoting PA among educational administrators warrant more attentions of professionals in the fields of health and physical education. Moreover, the recommended BMI cut-off values for Asian populations may need to be re-evaluated. More research is needed to investigate the correlation between administrators' PA and policies of PA promotion on campus.

Reference

Ainsworth, D. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R. Jr., Tudor-Locke, C.... & Leon, S. (2011). Compendium of physical activities: A second update of codes and MET values. *Medicine & Science in Sports & Exercise, 43*, 1575-1581.

Amireault, S., Godin, G., Lacombe, J., & Sabiston, C. M. (2015). The use of the Godin- Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. *BMC Medical Research Methodology, 15*(60). DOI 10.1186/s12874-015-0045-7

Anokye, N. K., Pokhrel, S., Buxton, M., & Fox-Rushby, J. (2013). Physical activity in England: Who is meeting the recommended level of participation through sports and exercise? *European Journal of Public Health, 23*(3), 458-464.

Blair, S. N., Hooker, S. P., Hutto, B., LaMonte, M. J., Tamara, P. & Pfeiffer, K. A. (2008). Daily steps in midlife and older adults: relationship with demographic, self-rated health, and self-rated physical activity. *Research Quarterly for Exercise and Sport, 79*, 128-132.

Burg, M. M., Schwartz, J. E., Kronish, L. M., Diaz, K. M., Alcantara, C., & Duer-Hefele, J. (2017). Does stress result in you exercising less? Or does exercising result in you being less stressed? Or is it both? Testing the bi-directional stress-exercise association at the group and Person (N of 1) level. *Annals of Behavioral Medicine, 51*, 799-809.

Byrne, D. W., Goetzel, R. Z., McGown, P. W., Holmes, M. C., Beckowski, M. S....Yarbrough, M.I. (2011). Seven-year trends in employee health habits from a comprehensive workplace health promotion program at Vanderbilt University. *Journal of Occupational and Environmental Medicine, 53*, 1372-1381.

Carlson, S. A., Fulton, J. E., Schoenborn, C. A. & Loustalot, F. (2010). Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans. *American Journal of Preventive Medicine, 39*(4), 305-313.

Carter, M. R., & Kelly, R. K. (2013). Self-reported health status, body mass index, and healthy lifestyle behaviors. *Workplace Health & Safety, 61*, 409-418.

Centers for Disease Control and Prevention. (2005). Adult participation in recommended levels of physical activity: United States, 2001 and 2003. *MMWR Morbidity and Mortality Weekly Report, 54*, 1208-1212.

Cheong, K. C., Yusoff, A. F., Ghazali, S. M., Lim, K. H., Selvarajah, S., Haniff, J.... Mustafa, A. N. (2012). Optimal BMI cut-off values for predicting diabetes, hypertension and hypercholesterolaemia in a multi-ethnic population. *Public Health Nutrition, 16*(3), 453-459.

Cholewa, S., & Irwin, J. D. (2008). Project IMPACT: Brief report on a pilot program promoting physical activity among university students. *Journal of Health Psychology, 13*, 1207-1212.

Corder, K., van Sluijs, E. M. F., Wright, A., Whincup, P., Wareham, N.J. & Ekelund, U. (2009). Is it possible to assess free-living physical activity and energy expenditure in young people by self-report? *American Journal of Clinical Nutrition, 89*, 862-870.

Dauenhauer, B. D., & Keating, X. D. (2011). Physical education programs and elementary school student physical activity. *Research Quarterly for Exercise and Sport, 82*, 512-520.

DeClercq, C. (2016). Toward the healthy campus methods for evidence-based planning and design. *Planning for Higher Education Journal, 44*(3), 86-96.

Deng, X., Castelli, D., Castro-Pinero, J., & Guan, H. (2011). University student meeting the recommended standards of physical activity and body mass index. *The ICHPER-SD Journal of Research, 6*(1), 20-26.

Deurenberg-Yap, M., & Deurenberg, P. (2003). BMI cut-off values for defining obesity among Asians. *Nutrition Reviews, 61*(Supplement s5), s80-s87.

Faught, E. L., Gleddie, D., Storey, K. E., Davison, C. M., & Veugelers, P. J. (2017). Healthy lifestyle behaviours are positively and independently associated with academic achievement: An analysis of self-reported data from a nationally representative sample of Canadian early adolescents. *PLoS ONE 12*(7), e0181938

Furtado, O., L. P. C., Lieberman, L. J., & Gutierrez, G. L. (2018). The outcomes of running a sport camp for children and youth with visual impairments on faculty members' teaching, research, and service activities: a case study. *Sport in Society, 21*(1), 76-90. DOI: 10.1080/17430437.2016.1225851

General Administration of Sport and China. (2008). *National fitness program*. Retrieved from: http://www.sport.gov.cn/n16/n1092/n16849/312943.html.

Gentry, W. A., Katz, R. B. & McKeeters, B. B. (2009). The continual need for improvement to avoid derailment: A study of college and university administrators. *High Education Research & Development, 28*, 335-348.

Godin, G. & Shephard, R. J. (1985). A simple method to assess

exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10*, 141-146.

Grant, M. C., & Baker, J. S. (2017). An overview of the effect of probiotics and exercise on mood and associated health conditions. *Critical Reviews in Food Science and Nutrition, 57*(18), 3887-3893, DOI: 10.1080/10408398.2016.1189872

Humphreys, B. R., McLeod, L., & Ruseski, J. E. (2014). Physical activity and health outcomes: Evidence from Canada. *Health Economics, 23*, 33-54.

Imai, K., Gregg, E. W., Chen, Y. J., Zhang, P., de Rekeneire, N. & Williamson, D. F. (2008). The association of BMI with functional status and self-rated health in US adults. *Obesity, 16*, 402-408.

Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*, 40. doi:10.1186/1479-5868-7-40.

Lassenius, O., Åkerlind, I., Wiklund-Gustin, L., Arman, M. & SÖderlund, A. (2013). Self-reported health and physical activity among community mental healthcare users. *Journal of Psychiatric & Mental Health Nursing, 20*(1), 82-90.

Lawler, M., Heary, C., & Nixon, E. (2017). Variations in adolescents' motivational characteristics across gender and physical activity patterns: A latent class analysis approach, *BMC Public Health, 17*, 661. DOI 10.1186/s12889-017-4677-x.

Johnston, C. S., Barkyoumb, G. M., & Schumacher, S. S. (2014). Vitamin C supplementation slightly improves physical activity levels and reduces cold incidence in men with marginal vitamin C status: A randomized controlled trial. *Nutrients, 6*, 2572-2583; doi:10.3390/nu6072572

Keating, X. D., Ayers, S., Liu, J., Zhou, K., Guan, J., Castro-Pinero, J., & Huang, Y. (2014) Physical activity patterns, perceived health, and BMI among university students. *American Journal of Health Studies, 28*(4), 163-172.

Keating, X. D., Guan, J., Castro-Pinero, J., & Bridges, D. (2005a). A Meta-Analysis of college student physical activity levels. *Journal of American College Health, 64*, 116-215.

Keating, X. D., Guan, J., Haung, Y., Deng, M., Wu, J., & Qu, S. (2005b). A cross-culture validation of the stages of exercise behavior change scale. *European Physical Education Review, 11*(1), 71-83.

Kirk, M. A., & Rhodes, R. E. (2011). Occupation correlates of adults' participation in leisure-time physical activity: A systematic review. *American Journal of Preventive Medicine, 40*(4), 476-485.

Kohl, H. W. III., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., GritLeetongin, G., & Kahlmeie, S. (2012). The pandemic of physical inactivity: global action for public health. *The Lancet, 380*(9838), 294-305.

Limm, H., Heinmüller, M., Liel, K., Seeger, K., Gündel, H., Kimil, A., & Angerer, P. (2012). Factors associated with differences in perceived health among German long-term unemployed. *BMC Public Health, 12*, 485.

Linnan, L, Weiner, B., Graham, A., & Emmons, K. (2007). Manager beliefs regarding worksite health promotion: Findings from the Working Healthy Project 2. *American Journal of Health Promotion, 21*(6), 521-528.

Lolokote, S., Hidru, T. H., Xiaofeng Li, & Li, X. (2017). Do socio-cultural factors influence college students' self-rated health status and health-promoting lifestyles? A cross-sectional multicenter study in Dalian, China. *BMC Public Health, 17*, 1-14. https://doi.org/10.1186/s12889-017-4411-8

Meyers, L. S, Gamst, G., & Guarino, A. J. (2016). *Applied multivariate research (2nd ed.)*. London: Sage Publications.

Milroy, J. J., Wyrick, D. L., Bibeau, D. L., Strack, R. W., & Davis, P. G. (2012). A university system-wide qualitative investigation into student physical activity promotion conducted on college campuses. *American Journal of Health Promotion, 26*(5), 305-312.

Monda, K. L., Gordon-Larsen, P., Stevens, J., & Popkin, B. M. (2006). China's transition: The effect of rapid urbanization on adult occupational physical activity. *Social Science & Medicine 64,* 858-870.

Murphy, J. J. (2017). Validity and reliability of three self-report instruments for assessing attainment of physical activity guidelines in university students. *Measurement in Physical Education and Exercise Science, 21*(3), 134-141.

Ng, S. W., Norton, E. C., & Popkin, B. M. (2009). Why have physical activity levels declined among Chinese adults? Findings from the 1991-2006 China Health and Nutrition Surveys. *Social Science & Medicine, 68*(7), 1305-1314.

Norman, P., & Bambra, C. (2007). Unemployment or incapacity? The utility of medically certified sickness absence data as an updatable indicator of population health. *Population, Space & Place, 135*, 333-352.

Orpana, H. M., Berthelot, J. M., Kaplan, M. S., Feeny, D. H., McFarland, B., & Ross, N. A. (2010). BMI and mortality: Results from a national longitudinal study of Canadian adults. *Obesity, 18*(1), 214-218.

Perry, C. K., Saelens, B. E., & Thompson, B. (2011). Intrapersonal, behavioral, behavioral, and environmental factor associated with meeting recommended physical activity among rural Latino youth. *Pediatric Exercise Science, 23*(4), 521-536.

Prosper, M. H., Moczulski, V. L., & Qureshi, A. (2009). Obesity as a predictor of self-rated health. *American Journal of Health Behavior, 33*(3), 319-329.

Rote, A. E. (2017). Physical activity intervention using Fitbits in an introductory college health course. *Health Education Journal, 76*(3), 337-348.

Schuring, M., Mackenbach, J., Voorham, T., & Burdorf, A. (2011). The effects of reemployment on perceived health. *Journal of Epidemiological Community Health, 65*(7), 639-644.

Shangguan, R., Keating, X. D., Liu, J., Zhou, K., Clark, L., & Leitner, J. (2017). Conceptual physical education course and college freshmen's physical activity patterns. *College Student Journal, 51*(2), 249-259.

Shibata, A., Oka, K., Nakamura, Y., & Muraoka, I. (2009). Prevalence and demographic correlates of meeting the physical activity recommendation among Japanese adults. *Journal of Physical Activity & Health, 6*(1), 24-32.

Troiano, R. P., Berrigan, D., Dodd, K. W., Mâsse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the U.S. measured by accelerometer. *Medicine & Science in Sports & Exercise,*

40(1), 181- 188.

U.S. Department of Health and Human Services. 2008 physical activity guidelines advisory committee report. Retrieved from http://www.health.gov/paguidelines/Report/.

World Health Organization. (2004). *Global strategy on diet, physical activity and health*. Geneva, Switzerland: World Health Organization.

World Health Organization. (2010). *Global recommendations on physical activity for health*. Geneva, Switzerland: World Health Organization.

Yuan, C., Lv, J., & VanderWeele, T. J. (2013). An assessment of health behavior peer effects in Peking University dormitories: A randomized cluster-assignment design for interference. PLoS ONE, 8(9), e75009. doi:10.1371/journal.pone.0075009

Zeng, Q., He, Y., Dong, S., Zhao, X., Chen, Z., Song, Z., ... Wang, Y. (2014). Optimal cut-off values of BMI, waist circumference and waist:height ratio for defining obesity in Chinese adults. *British Journal of Nutrition, 112*, 1735-1744. ■