Influences of Lifestyle Profiles and Problematic Internet Use on Mental Distress in University Students

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Declarations

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Conflict of Interest

The authors declare that there are no conflicts of interest with respect to the research, authorship, and publication of this article.

Availability of data and material

The dataset for the current study is available at <https://data.mendeley.com/datasets/gw86x9tfzp/1>

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethics approval was obtained from the ethics committee of the Department of Rehabilitation Sciences at the Hong Kong Polytechnic University.

Consent to participate

Informed consent was obtained from all participants included in the study.

Consent for publication

All authors have read the manuscript and have approved for its publication.

Abstract

Hong Kong university students suffer a high prevalence of mental distress, but their lifestyle behaviors are not well-understood. We aimed to examine the relationship between mental distress, lifestyle behaviors, and problematic Internet use of this student population during the summer holiday and term-time. A two-cohort contrast group survey study was conducted. Students were surveyed in July during the summer holiday and September during term-time. The General Health Questionnaire-12, Health Promoting Lifestyle Profile II, and Generalized Problematic Internet Use Scale 2 were administered to measure mental distress, lifestyle behaviors, and problematic Internet use. 949 students (summer=467; term-time=482; $M_{age} \pm SD$, 20.11 ± 1.54) participated in the study. Students reported statistically significant lower mental distress and higher spiritual growth during the summer holiday compared to term-time. The results of Structural Equation Modelling (SEM) found that spiritual growth was directly associated with reduced mental distress and problematic internet use, and indirectly associated with reduced mental distress through a negative correlation with problematic internet use. Problematic internet use was positively correlated with mental distress. Physical activity was more associated with better mental health during the summer holiday and for female students. In contrast, Health management was associated with better mental health during term-time and for male students. In conclusion, spiritual growth supports mental health improvement and counters problematic internet use in university students in general, factors such as physical activity and health management show differential influences based on gender and time of year. Results may help inform the development of student support workshops in higher education.

Key words: mental health, problematic Internet use, spiritual growth, lifestyle behaviors, university students

Introduction

Mental health of university students has become a major societal concern in recent years. Psychological distresses such as depression and anxiety are increasingly reported among university students (Deasy, Coughlan, Pironom, Jourdan, & Mannix-McNamara, 2014; Eisenberg, Golberstein, & Gollust, 2007; Eisenberg, Hunt, Speer, & Zivin, 2011; Lun et al., 2018; Vankim & Nelson, 2013; Wong, Cheung, Chan, Ma, & Tang, 2006). This problem is especially serious among students in Hong Kong, where a large scale ($n = 7915$) web-based survey of first-year university students identified moderate-to-severe depression, anxiety, and stress in 21%, 41%, and 27% of the sample, respectively (Wong et al., 2006). More recent work supports that prevalence rates for mild to severe depressive (68.5%) and anxiety symptoms (54.4%) are showing an upward trend in this demographic (Lun et al., 2018). One possible explanation for these poor mental health outcomes stems from environmental stressors associated with the university student experience. Various academic and course-related difficulties, the transition from adolescence into early adulthood, financial and employment uncertainties, increased pressure to succeed, and overuse of technology may contribute to the observed outcomes (Kwan, Cairney, Faulkner, & Pullenayegum, 2012; Li, O'Brien, Snyder, & Howard, 2015; Lun et al., 2018).

Lifestyle behaviors are crucial factors for the general well-being of people, including university students (Deasy et al., 2014; Deasy, Coughlan, Pironom, Jourdan, & McNamara, 2015; DeBate, Gatto, & Rafal, 2018; Eisenberg et al., 2011; Hawker, 2012; Hsiao, Chien, Wu, Chiang, & Huang, 2010; Skead & Rogers, 2016; Vankim & Nelson, 2013; Zhang et al., 2014). Young university students are transitioning from adolescence to young adulthood during which time lifestyle behaviors are under development, setting a behavioral foundation that will affect

lifelong health (Bell & Lee, 2006). University students who experience higher levels of stress are more likely to engage in problematic lifestyle behaviors such as smoking and alcoholism (Deasy et al., 2014; Deasy et al., 2015). In contrast, students with positive coping styles are likely to respond to stress by engaging in behaviors such as help-seeking from professionals, families, and friends (Hawker, 2012; Hsiao et al., 2010; Skead & Rogers, 2016; Vankim & Nelson, 2013; Wong et al., 2006; K. C. Zhang et al., 2014). Recently, technology overuse has been identified as a significant negative lifestyle factor in university students (Dong, Lu, Zhou, & Zhao, 2011; Li et al., 2015; B. Q. Wang, Yao, Zhou, Liu, & Lv, 2017; Zhang et al., 2015) and is thought to be associated with deterioration in academic performance, mental health, and well-being (Casale, Lecchi, & Fioravanti, 2015; Derbyshire et al., 2013; Dong et al., 2011; Li et al., 2015; Wang et al., 2017; Wong et al., 2006). Together, these findings support the importance of developing healthy lifestyle behaviors in young university students during the transition into young adulthood in support of continued mental health and well-being.

The present study was carried out in order to better understand the relationship between lifestyle behaviors and mental distress in Hong Kong university students. Because university students experience a high level of mental distress (Lun et al., 2018; Wong et al., 2006), there is a need to increase our understanding of the possible influence of lifestyle behaviors. Moreover, to our knowledge, there have been no studies investigating whether the relationship between lifestyle behaviors and mental distress in this demographic differ based on the time of year. During the summer holiday, students have more leisure time to enjoy their favorite activities which should lead to lower mental distress (Kull, Ainsaar, Kiive, & Raudsepp, 2012). In contrast, during term-time (i.e., when courses are in session) students experience a higher level of academically-related mental distress (Lun et al., 2018), necessitating a change in lifestyle

behaviors in order to cope successfully. Accordingly, we hypothesized that lifestyle behavior factors would be significant predictors of mental distress in university students. Additionally, problematic Internet use would be positively correlated with mental distress. Finally, we hypothesized that there would be significant differences in the relationship between mental distress and lifestyle behaviors between the summer holiday and term-time.

Method

Participants

All recruited participants were full-time undergraduate students studying at the Hong Kong Polytechnic university. The inclusion criteria were: full-time undergraduate students between 17 and 25 years who had previously completed the Hong Kong Diploma of Secondary Education (HKDSE), indicating they grew up in Hong Kong.

Study Design

This study adopted a two-cohort contrast group survey design. The subjects were recruited through convenience sampling. All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional, state research committee, and with the 1964 Helsinki declaration and its later amendments.

Instruments

Three separate self-report questionnaires were used in the present work. The Chinese version of the General Health Questionnaire (GHQ-12) (Li, Chung, Chui, & Chan, 2009) was used to assess general mental distress. The Chinese short version 30-item Health Promoting Lifestyle Profile II (HPLP-II) (Teng, Yen, & Fetzer, 2010) was included to measure five different aspects of

lifestyle behaviors: physical activity, nutrition, spiritual growth, health responsibility and health management. Finally, the Generalized Problematic Internet Use Scale 2 (GPIUS2) (Caplan, 2010) was used to measure problematic Internet use. Detailed descriptions of these instruments and their analysis are provided in the appendix.

Procedure

Because the summer holiday for Hong Kong universities typically begins at mid-June and ends in the first week of September, the summer holiday cohort was surveyed from the first week of July to the last week of August. The term-time cohort was surveyed from the last week of September to the end of October, 2015 after the start of the fall semester. During data collection, experimenters approached potential participants on the university campus and described the purpose of the study to them. A participant who satisfied the inclusion criteria was invited to take part in the survey. Informed consent was obtained from each participant. A questionnaire consisting basic demographic items and the three instruments was distributed to the participant for completion at the site. Participants were instructed to complete the survey based on his or her experience of general mental health, lifestyle behaviors, and Internet use during the past week. The questionnaire took approximately twenty minutes to complete during which the experimenter provided assistance if the participant had a problem understanding the item in the questionnaire.

Data Analysis

Data analyses were performed with the IBM Statistical Package for the Social Sciences (SPSS) version 21. Homogeneity of variances was tested with Levene's Test of Equality of Error Variances with $p > 0.05$. A two-way analysis of variance (ANOVA) was used to examine the independent variables: time (summer holiday versus term-time) and gender (male versus female) on GHQ-12 score measuring mental distress or the GPIUS2 composite score measuring general problematic internet use. Significant interaction effects were followed by post-hoc one-way ANOVAs. Similarly, two-way multivariate analysis of variance (MANOVA) was used to examine the effects of time and gender on the five HPLP-IICR lifestyle factors. Significant interaction effects were followed by post-hoc one-way ANOVAs.

Path analyses were conducted to explore the effects of the five HPLP-IICR lifestyle factors and problematic internet use on mental distress using Structural Equation Modelling (SEM) with IBM SPSS Amos 21. An overall model that represented the whole dataset was first developed. The model fit was assessed by goodness-of-fit (GoF) test and fit indices including root mean square of error approximations (RMSEA), goodness-of-fit Index (GFI), adjusted goodness of fit index (AGFI) and relative fit index (RFI). For an acceptable model fit, chi-square (χ^2) values should be close to zero with $p > 0.05$ for the GoF test. In terms of fit indices, RMSEA should be below 0.08. GFI, AGFI and RFI should exceed 0.9 (Bollen, 1987; MacCallum, Browne, & Sugawara, 1996). Following the analyses with GoF and fit indices, the SEM was further refined by directional testing of the factor loadings ($p < 0.05$). The overall model was further developed into SEMs for the time and gender subgroups. We conducted structural invariant testing to confirm the overall model was a valid representation of time and gender subgroups (Byrne, 2004).

Results

In total, 949 students (summer = 467; term-time = 482; $M_{\text{age}} \pm \text{SD}$, 20.11 ± 1.54 years) participated in the study. All students were Chinese and had previously completed the HKDSE. Table 1 presents the demographic information of the participants.

Differences in mental health between gender and time

Two-way ANOVA found that there was a significant main effect of time in GHQ-12 [$F(1, 949)=5.40, p=0.02$, partial $\eta^2=0.01$]. University students experienced higher mental distress during the term (mean $\pm$ SD) [95% CI], (13.47 ± 5.22) [12.97, 13.96] compared to the summer holiday (12.65 ± 5.81) [12.13, 13.13]. There was no significant difference in GHQ-12 scores between female (13.35 ± 5.83) [12.86, 13.84] and male students (12.75 ± 5.16) [12.23, 13.25] ($p=0.09$). No significant interaction effect was found between time and gender ($p=0.49$).

Problematic internet use by time and gender

Two-way ANOVA found that there was a significant main effect of gender [$F(1, 949)=5.89, p=0.02$, partial $\eta^2=0.01$]. Male students experienced significantly higher problematic internet use (33.77 ± 6.94) [33.15, 34.38] than females (32.72 ± 6.32) [32.14, 33.3]. There was no significant difference in GPIUS2 scores between the term-time (33.47 ± 6.77) [32.91, 34.09] and the summer holiday (32.94 ± 6.48) [32.38, 33.58] ($p=0.14$), and no significant interaction effect between time and gender ($p=0.86$).

Differences in lifestyle behaviors between time and gender

Two-way MANOVA showed that there were significant main effects of time [$F(5, 941)=4.93$, $p<0.001$, partial $\eta^2=0.03$] and gender [$F(5,941)=15.22$, $p<0.001$, partial $\eta^2=0.08$] on the HPLP-IICR subscales. For the time effect, students had significantly higher scores on spiritual growth in the summer holiday (2.72 ± 0.52) [2.67, 2.77] than the term-time (2.59 ± 0.53) [2.54, 2.63], [$F(1,945)=15.72$, $p<0.001$, partial $\eta^2=0.02$]. Moreover, male students (2.35 ± 0.56) [2.29, 2.4] had significantly higher scores in physical activity than female students (2.10 ± 0.53) [2.05, 2.15], [$F(1,945)=47.98$, $p<0.001$, partial $\eta^2=0.05$]. In contrast, female students (2.54 ± 0.43) [2.51, 2.58] had significantly higher score in health management than male students (2.49 ± 0.43) [2.45, 2.53], [$F(1,945)=3.96$, $p=0.047$, partial $\eta^2=0.01$]. There was no significant interaction between time and gender effect ($p=0.87$). Table 2 provides a summary of the GHQ-12, GPIUS2 composite scores and HPLP-IICR subscales by time and gender.

Relationship between mental health, lifestyle and problematic internet use

Five SEMs were established to predict mental distress with lifestyle behaviors and problematic internet use. Details of the SEM development including the results of model fit, directional testing, and structural invariance analyses are provided in the appendix. The first SEM developed was an overall model using the whole dataset to predict mental distress with lifestyle factors and problematic internet use (Figure 1a). The other four models were established from the overall model to predict mental distress in the two time periods (Figure 1b & c) and genders (Figure 1d & e). The results of GoF and fit indices of all five SEMs showed a good to near perfect fit (Table 3). Table 4 presents the results of directional testing between exogenous and endogenous variables in the five optimized SEMs. The multiple R^2 for mental distress ranged from 0.105 to

0.136, which indicated from 10.5% to 13.6% of variances in mental distress were explained by the SEMs.

In all five SEMs, there were two direct effects, Problematic internet use and spiritual growth, which consistently predicted mental distress (Figure 1a-e). Problematic internet use [standardized coefficients (β) of 0.11 to 0.16, $p=0.005$ to <0.0001] was positively correlated with mental distress whereas spiritual growth ($\beta=-0.173$ to -0.248 , $p<0.0001$) was negatively correlated with mental distress. Moreover, spiritual growth has an indirect effect, a negative correlation with mental distress mediated through problematic internet use ($\beta=-0.03$ to -0.04 , $p<0.0001$) (Table 4 & Figure 1a-e). When problematic internet use was considered as an endogenous variable, spiritual growth was negatively correlated with problematic internet use ($\beta=-0.19$ to -0.24 , $p<0.0001$), $R^2=0.036$ to 0.06 , which explained 3.6% to 6% of variance (Figure 1a-e).

Other lifestyle factors that predicted mental distress

There were other specific correlations between lifestyle factors and mental distress. In the overall model, Physical activity ($\beta=-0.08$, $p=0.005$) and health management ($\beta=-0.09$, $p=0.01$) were both negatively correlated with mental distress (Figure 1a). However, physical activity was negatively correlated mental distress in the summer holiday ($\beta=-0.13$, $p=0.004$) (Figure 1b) and for female ($\beta=-0.2$, $p=0.004$) (Figure 1e) but not the term-time and male student models (Figure 1c & d). In contrast, Health management was negatively correlated with mental distress in the term-time ($\beta=-0.12$, $p=0.01$) (Figure 1c) and for male models ($\beta=-0.18$, $p=0.001$) (Figure 1d).

Discussion

In this study, we reported the relationship between mental distress, lifestyle behaviors, and problematic Internet use along with their differences between the summer holiday and term-time in Hong Kong university students. The major finding was that spiritual growth was found to be central for the promotion of better mental health and the reduction of problematic Internet use in university students.

Spiritual growth: a solution for both problematic Internet use and mental distress

Internet overuse has been identified as a serious lifestyle problem of university students with higher levels associated with depression, anxiety, impulse control, and psychosocial issues (Casale et al., 2015; Derbyshire et al., 2013; Dong et al., 2011; Li et al., 2015; Wang et al., 2017). Structural models in the present work identified that problematic Internet use was the only factor positively correlated with mental distress (Figure 1), aligning with these previous reports. Additionally, our results indicated that males had slightly greater problematic Internet use than female students (Table 2). Previous studies found that young males with internet addiction, were more likely to suffer from mood or anxiety related problems (Derbyshire et al., 2013) and reported higher levels of negative personal, social, and professional outcomes (Casale et al., 2015) when compared to young females. Our results support that higher levels of spiritual growth may be associated with reduced problematic internet use (Figure 1). This identified relationship is further supported by recent findings that Chinese university students with higher sense of meaning in life, one of the components in spiritual growth, were less likely to suffer from internet addiction (Zhang et al., 2015).

Among the lifestyle behaviors investigated, spiritual growth was the most important factor that related to mental health of university students. Higher spiritual growth was associated with reduced mental distress as well as decreased problematic Internet use (Figure 1). The spiritual growth dimension in HPLP-IICR refers to, “The development of internal resources through transcending, connecting, and developing”, with items focused on purpose and meaning in life, and looking forward to future experiences, and challenges.(Teng et al., 2010) These findings were consistent with previous findings that higher spiritual values in university students were associated with higher quality of life (Zhang et al., 2014) and a lower likelihood of suffering from depression or the negative effects of stress (Hsiao et al., 2010). Therefore, students with higher spiritual growth may be better protected from mental distress.

People with higher spiritual values see problems in life as opportunities to improve and challenge themselves. Reframing life’s problems and having curiosity to discover purpose in life may have a protective effect against mental distress (Gall, Charbonneau, Clarke, Joseph, & Shouldice, 2005). Thus, the promotion of spiritual growth may be crucial for improving mental health of university students, a conclusion supported by intervention research identifying lasting mental health benefits associated with participation in a nine week meaning-centered counselling intervention (Cheng, Hasche, Huang, & Su, 2015).

Health management is especially important during the academic term

The health management factor in HPLP-IICR involves the use of psychological and physical resources to manage stress and social communications to enrich interpersonal relations (Teng et al., 2010). A meta-analysis that included twenty-four studies involving 1431 university students found that stress management intervention programs were effective in reducing symptoms of

mental distress including anxiety, depression, and stress hormone level in university students (Regehr, Glancy, & Pitts, 2013). Moreover, university students who had good health management strategies such as stress coping and social support were less likely to experience mental distress (Lun et al., 2018; Wang, Xiong, & Yang, 2018). These recent findings were consistent with our finding that higher health management was associated with lower mental distress (Figure 1a), especially during the term-time (Figure 1c). This time difference may be related to differences in stress associated with the academic term that are perhaps absent during the Summer holiday (Lun et al., 2018).

Our results indicated that males had significantly lower health management scores than females (Table 2). Moreover, health management was associated with lower mental distress in males but not female (Figure 1d). Differences in health-related behaviors based on gender have previously been reported. When experiencing mental distress, male university students were less likely to seek help, receive professional treatment, or receive social support from family and friends in comparison to female students (Eisenberg et al., 2007; Eisenberg et al., 2011). Gender differences in help-seeking behavior may relate to norms of male masculinity perpetuating the stereotype that help-seeking is for the weak (Ogrodniczuk, Oliffe, Kuhl, & Gross, 2016), and may be further exacerbated by the stigma associated with mental illness (DeBate et al., 2018). Together, these findings suggest that male university students may benefit from the development of health management skills such as help-seeking and social supports, which are important for improving their mental health.

Summer is a time of maximal benefit for physical activity

Physical activity is associated with lower levels of mental distress overall (Figure 1a), consistent with the recent finding that exercise is negatively related to depression in university students (Lun et al., 2018). Our results further revealed that physical activity was especially beneficial during the summer holiday (Figure 1b) and for female students (Figure 1e). Previous studies found that higher levels of physical activity were related to better mental health, life satisfaction, and self-esteem in university students (Ghorbani et al., 2014; Hawker, 2012; Skead & Rogers, 2016). During the transition from adolescence to young adulthood, university students typically experience a reduction in physical activity (Kwan et al., 2012), as well as an increase in body weight during their first year of studies (Vella-Zarb & Elgar, 2009). These findings support the idea that more physical activity is beneficial to both physical and mental health of university students. Furthermore, physical activity was specifically associated with lower mental distress during the summer holiday (Figure 1b). Physical activities performed during leisure time have previously been found to lower depression (Kull et al., 2012) and increase health-related quality of life (Jurakic, Pedisic, & Greblo, 2010) and life satisfaction (Pedisic, Greblo, Phongsavan, Milton, & Bauman, 2015), while work-related physical activity was found to increase depression (Kull et al., 2012). During the summer holiday, university students have more leisure time to engage in physical activity, which may explain the time-related differences identified in the present study.

Physical activity was associated with lower mental distress in female students in our sample (Figure 1e). This may be related to gender differences in attitudes towards physical exercise. Female students believed that exercise was more related to mental health related issues such as body image and self-esteem (Kabir, Zafar, & Waslien, 2013; Kamarudin & Omar-fauzee,

2007), while male students were more concerned about improving strength and fitness (Kamarudin & Omar-fauzee, 2007). Female students with more ideal body images also had better self-image and self-esteem than those who considered themselves as obese (Kabir et al., 2013). On the other hand, female students typically engage in less physical exercise when compared with males, a trend emerging during adolescence (Kwan et al., 2012; Vankim & Nelson, 2013). Interventions aimed at increasing interest in and opportunities for physical activity for female students may help address gender differences in participation, and support females in maximally benefiting from these activities.

Implication

Intervention programs that promote mental health of university students are effective and may have long-term benefits. A recent meta-analysis found that the positive effects of therapies for reducing mental distress, especially anxiety and depression, were found to persist up to 18 months after interventions (Winzer, Lindberg, Guldbrandsson, & Sidorchuk, 2018). In addition, intervention programs help shape the lifestyles of young students during this critical developmental period (Bell & Lee, 2006). The present study revealed important insights into the contemporary lifestyle behaviors of Hong Kong university students, including how these behaviors may differentially relate to mental health. Additionally, differences in the relationship between these behaviors and mental health outcomes based on time of year and gender were identified which may help inform the design and deliver of future interventions. Student support staff in higher education may want to consider developing programs that nurture spiritual growth including awareness of meaning and purpose in life, the search of goals in life, and the anticipation of future challenges. Workshops of this nature may be especially important during

the academic term when reported spiritual growth is low in comparison to the summer holiday.

Promoting spiritual growth may protect students from mental distress and counteract problematic lifestyle behaviors in support of mental health and well-being.

Limitations

The current study had several limitations. The main limitation was that this was a cross-sectional design and different groups of students were recruited in the two cohorts. Our identified time difference in lifestyle and mental health may partly reflect differences in sample characteristics.

Future studies using a longitudinal approach would be better for comparison across time.

Additionally, the recruitment of students was through convenience sampling in one local university, which may limit the generalizability of our findings. Finally, the variance explained in mental distress by lifestyle behaviors in this study was small (10.5% to 13.6%). However, this is consistent with previous studies of similar populations in which the variance explained was typically small (1% to 16%) (Bi et al., 2014; Deasy et al., 2014; Doron, Trouillet, Maneveau, Ninot, & Neveu, 2015; Hsiao et al., 2010; Ma, Xu, Zhou, Ma, & Wang, 2018). This may be partly due to the absence of measures related to academic or course-related stressors (Prymachuk & Richards, 2007).

Conclusion

This study identified how lifestyle behaviors and problematic Internet use influence mental health in Hong Kong university students. Higher spiritual growth was generally associated with lower problematic Internet use and mental distress. Physical activity and health management were beneficial lifestyle behaviors although gender and time of year may influence the

willingness to engage in or benefit of these behaviors on mental health. These findings have the potential to inform the development of student support interventions in higher education aimed at developing healthy lifestyle behaviors.

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Table 1. Sample characteristics of the university students during both times

Age	Summer holiday		Term-time		Total
	Male	Female	Male	Female	
17	4	4	6	9	23
18	13	18	49	52	132
19	34	44	45	56	179
20	63	66	61	38	228
21	62	86	30	71	249
22	21	17	19	19	76
23	15	8	12	7	42
24	3	4	2	1	10
25	4	1	4	1	10
Total	219	248	228	254	949
Year of study					
1	29	36	78	75	218
2	62	53	57	56	228
3	124	145	57	36	362
4	4	14	36	87	141
Total	219	248	228	254	949

Table 2. Descriptive statistics for the GHQ-12, GPIUS2 composite scores, and HPLP-IICR subscale scores by Time and Gender

Scales	Time		95% CI S - T	Gender		95% CI M - F
	Summer	Term-time		Male	Female	
GHQ-12	12.65 ± 5.81	13.47 ± 5.22	-1.54, -0.13	12.75 ± 5.16	13.35 ± 5.83	-1.31, 0.1
GPIUS2	32.94 ± 6.48	33.47 ± 6.77	-1.37, 0.32	33.77 ± 6.94	32.72 ± 6.32	0.2, 1.89
HPLP-IICR						
Spiritual	2.72 ± 0.52	2.59 ± 0.53	0.07, 0.2	2.64 ± 0.55	2.67 ± 0.51	-0.09, 0.04
Physical	2.20 ± 0.54	2.23 ± 0.58	-0.09, 0.05	2.35 ± 0.56	2.10 ± 0.53	0.18, 0.32
Management	2.53 ± 0.43	2.51 ± 0.44	-0.04, 0.07	2.49 ± 0.43	2.54 ± 0.43	-0.11, -0.001
Nutrition	2.49 ± 0.46	2.46 ± 0.44	-0.03, 0.09	2.45 ± 0.45	2.50 ± 0.46	-0.11, 0.01
Responsibility	1.84 ± 0.58	1.89 ± 0.57	-0.12, 0.02	1.85 ± 0.51	1.82 ± 0.54	-0.03, 0.10

Management: Health Management; Responsibility: Health Responsibility; Data for time and gender are presented as Mean ± SD; 95% CI, 95% confidence interval of mean difference; S – T, Summer holiday – term time; M – F, male – female.

Table 3. Model fit data for the five structure models established with path analyses summary

Model	N	chi-square			Model of fit indices			
		χ^2	df	<i>p</i>	RMSEA	GFI	AGFI	RFI
Overall	949	0.09	2	0.956	0.0001	1	1	0.999
Summer	467	0.001	1	0.978	0.0001	1	1	1
Term-time	482	0.219	1	0.64	0.0001	1	0.998	0.995
Male	447	2.48	1	0.116	0.058	0.997	0.972	0.948
Female	502	0.042	1	0.837	0.0001	1	1	0.998

Summer: Summer holiday; χ^2 : chi-square; df: degrees of freedom; *p*, p-value for chi-square; RMSEA: Root Mean Square of Error Approximations; GFI: Goodness of Fit Index; AGFI: Adjusted Goodness of Fit Index; RFI: Relative fit index.

Table 4. Directional effects between exogenous and endogenous variables in all SEM models

Model	Endogenous variable	Exogenous variable	Directional effect				
			Regress			Multiple R ²	
			SE_b	p-values	beta	Internet	Mental
Overall	Internet	Spiritual	-2.72	***	-0.22	0.047	0.113
	Mental	Internet	0.11	***	0.13		
	Mental	Spiritual	-1.97	***	-0.19		
	Mental	Physical	-0.78	**	-0.08		
	Mental	Manage	-1.13	*	-0.09		
Summer	Internet	Spiritual	-2.38	***	-0.19	0.036	0.105
	Mental	Internet	0.10	**	0.11		
	Mental	Spiritual	-2.48	***	-0.22		
	Mental	Physical	-1.34	**	-0.13		
Term	Internet	Spiritual	-3	***	-0.24	0.055	0.115
	Mental	Internet	0.12	***	0.16		
	Mental	Spiritual	-1.73	***	-0.18		
	Mental	Manage	-1.48	*	-0.12		
Male	Internet	Spiritual	-2.37	***	-0.19	0.036	0.136
	Mental	Internet	0.09	**	0.12		
	Mental	Spiritual	-1.73	***	-0.19		
	Mental	Manage	-2.16	**	-0.18		
Female	Internet	Spiritual	-3.05	***	-0.24	0.06	0.11
	Mental	Internet	0.15	***	0.16		
	Mental	Spiritual	-2.27	***	-0.12		
	Mental	Physical	-1.26	**	-0.2		

Summer: Summer holiday; Internet: problematic Internet use; Mental: mental distress; Spiritual: spiritual growth; Physical: physical activity; Manage: health management; Regress: regression weights; SE_b: unstandardized coefficient; beta: standardized coefficient; *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

Figure 1

Figure Caption

Figure 1. Structural equation models **a.** Overall model. **b.** Model developed using data from the summer holiday. **c.** The model developed using data from term-time. **d.** Model developed using data from males. **e.** Model developed using data collected from females.