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RESEARCH ARTICLE

Does outdoor education work equally for everyone? Examine influence of OEP on mental health and well-being in university students

Peng Wang[1,2], Mohd Yasim Mazuki[3,*]

[1] *Faculty of Sport Science and Coaching, Sultan Idris Education University, Tanjong Malim, Perak, 35900, Malaysia*

[2] *Department of Physical Education, Hengshui College of Vocational Technology, Hengshui, 053000, China*

[3] *Faculty of Sport Science and Coaching, Sultan Idris Education University, Tanjong Malim, Perak, 35900, Malaysia*

*** Corresponding author:** Mohd Yasim Mazuki, mazuki@fsskj.upsi.edu.my

ABSTRACT

This study examines the relationship between outdoor education programs (OEPs) and mental health outcomes among Chinese university students, with a specific focus on demographic moderators. Adopting a quasi-experimental pretest-posttest control group design, 240 first-year undergraduates from Hengshui University were purposively sampled and assigned to either an experimental group (n=120) participating in a 5-day OEP or a waitlist control group (n=120). Data were collected using validated Mandarin versions of the GHQ-12 and GWB scales, and analyzed via paired t-tests, ANOVA, and independent samples t-tests to assess intervention effects and demographic influences. The results indicated three key outcomes: (1) The outdoor education program led to substantial improvements in positive emotions and self-confidence, reductions in negative emotions and stress. (2) Demographic factors significantly moderated mental health outcomes (χ^2=3.258, F=9.819, p=0.002), yet no statistically significant effects were observed on well-being (χ^2=1.709, F=1.578, p=0.210). (3) Treatment effects varied significantly across gender, age, academic discipline, and place of residence ($p < 0.05$), while prior outdoor experience and household income showed no moderating effects on mental health or well-being; The results contribute to theoretical frameworks by demonstrating the moderating effects of demographic variables on OEP efficacy, aligning with social cognitive theory and cultural adaptation models. Practically, these findings advocate for the development of demographic-specific OEPs to address differential needs, particularly among female students, physical education majors, and urban residents.

Keywords: outdoor education; moderating effects; demographic factors; mental health; well-being

1. Introduction

The increasing prevalence of mental health issues among university students has garnered significant scholarly attention, with estimates indicating rising rates of anxiety, depression, and stress (Hunt & Eisenberg, 2010; Stallman, 2010). This trend underscores the critical need for evidence-based interventions to support student well-being in higher education settings.Past studies have reported on the rate of increasing mental health problems among university students (Hunt, Mahmoud et al., 2012; Saleh et al., 2017; Stowell

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et al., 2021). Transitioning to higher education subjects students to multifaceted stressors, including academic pressure, cultural adjustment, and financial challenges (Beiter et al., 2015). Outdoor education, as a nature-based intervention, has been proposed to mitigate these stressors through activities promoting social interaction, resilience, and environmental engagement (Jackson et al., 2021). Theoretical underpinnings, such as Bandura's social cognitive theory and Kolb's experiential learning model(Kolb, 1984), posit that OEPs enhance self-efficacy, emotional regulation, and problem-solving skills through immersive, reflective experiences.

Despite growing interest in outdoor education, limited empirical evidence exists regarding its systematic integration into formal educational curricula (Solomonian et al., 2022; Sprague et al., 2020). While previous studies highlight its potential for improving physical health and reducing illness risk (Ekenga et al., 2019; Trapasso et al., 2018), the mental health outcomes of innovative community-recreation partnerships require further investigation (Cohen et al., 2022; Sheldrake & Reiss, 2022). In the Chinese context, existing research faces challenges related to cultural adaptation of interventions and unclear theoretical mechanisms, necessitating studies grounded in local sociocultural frameworks. Grounded in social cognitive theory, this review synthesizes empirical findings and investigates the impacts of outdoor education within the context of Chinese culture,especially focuses on the differentiated effect of demographic factors on the impacts.

2. Literature review

Outdoor education is defined as "education in, about, and for the out of doors" (Donaldson & Donaldson, 1958). Outdoor education is purposeful and are designed for outdoor experiences that conceals a very wide and rich area according to the Institute Outdoor Learning (Prince, 2018).Accumulating evidence supports the mental health benefits of outdoor education, with randomized controlled trials documenting improvements in emotional regulation and stress reduction (Avci & Gumus, 2020; Bragg, 2016). Specifically, elementary school interventions have shown enhanced academic performance and cognitive functioning, particularly in memory retention tasks (Avci & Gumus, 2020).Yang et al. (2022) investigated the effect of a health education program, which included outdoor elements, on Chinese tertiary students and found improvements in their well-being, self-efficacy, and health-related behaviors.

University students face numerous problems in terms of academic achievement, cultural changes and financial challenges during their studies at the higher institutions (Beiter et al,2015).Past studies of on outdoor education offer an extensive amount of information about the positive aspects it has on the psychological behaviours of students (Ekenga et al., 2019).Outdoor education programs facilitate nature engagement, skill development, and social interaction—key components linked to positive psychological outcomes (Jackson et al., 2021; Stowell et al., 2021). Although meta-analyses confirm stress reduction and mood enhancement (White et al., 2019; Tillmann et al., 2023; Barton & Pretty, 2023), the generalizability of these findings across diverse populations remains underexplored, particularly in non-Western contexts.

Recent studies indicate that demographic variables significantly moderate OEP outcomes, with gender, urbanicity, socioeconomic status, and academic discipline identified as key moderators (Fen et al., 2016; Zhang & Chen, 2019). For instance, female students demonstrate greater stress reduction in nature-based programs, while STEM majors report lower engagement compared to humanities students (Li & Wong, 2018; Zhou et al., 2021). Li and Wong (2018) found that Chinese female students exhibited a 23% greater reduction in anxiety compared to males after a 10-week forest therapy program, aligning with theories that women are more responsive to nature-based social bonding activities . Conversely, males may derive more physical health benefits; a meta-analysis by Mygind et al. (2019) showed that male participants in wilderness programs experienced larger increases in self-esteem, possibly due to culturally reinforced risk-taking

behaviors. Emerging adulthood (ages 18–25) represents a critical window for OEP efficacy due to ongoing neuroplasticity and identity formation (Arnett, 2015). However, age-related differences in OEP responsiveness are mediated by evolving psychosocial priorities.A Beijing study found that literature majors reported 2.3× more sustained stress reduction than engineering students after identical OEPs (Zhou et al., 2021), suggesting STEM curricula emphasizing analytical thinking may inhibit embodied nature connection.Urban Chinese students, characterized by limited nature access in high-density environments (Wang et al., 2022), exhibit greater initial improvements in psychological well-being during OEPs compared to rural counterparts. This disparity may reflect urban residents' novelty response to natural settings versus rural students' daily environmental familiarity.

Notably, 78% of OEP studies are conducted in Europe and North America (Prince, 2020), leading to significant cultural bias in theoretical frameworks. China's rapid urbanization and competitive academic environment introduce unique contextual factors, including nature deficit disorder and academic burnout, which require culturally specific interventions not accounted for in existing models. By contextualizing mediating variables within China's sociocultural framework, this analysis bridges gaps in existing literature, particularly regarding the understudied role of demographic moderators. The Hengshui University investigation contributes to the field through:

(1) Testing OEP efficacy in a high-stress Chinese educational environment.

(2) Disaggregating treatment effects by gender, age, academic discipline, and residential background,previous experience and household income.

Guided by these considerations, this study addresses two key research questions:

(1) What are the effects of outdoor education programs on the mental health and well-being of first-year undergraduates at Hengshui University?

(2) How do demographic variables (gender, age, academic discipline, place of residence) moderate these effects?

3. Methodology

3.1. Research design

By adopting a quasi-experimental pretest-posttest control group design, this study evaluates the differential effects of a 5-day outdoor education program (OEP) on mental health outcomes among first-year undergraduates at Hengshui University. The design explicitly examines demographic moderators, including gender, age, academic major, urban/rural residence,previous experience and household income. The effectiveness of true experimental design**s includes samples** selected based on random sampling in investigating cause and effects relationships in a scientific and systematic research (Babbie, 2005; Baumgartner & Hensley, 2006; Bell, 2003).Nevertheless, this type of design has its disadvantages, like reducing the population involved ,hence it may result in condensing the generalisation of the research findings and outcomes (Vaske, 2008). To enhance ecological validity, a non-random purposive sampling strategy was employed, matching experimental (n=120) and control (n=120) groups on baseline characteristics. This design, consistent with Aivazidis et al. (2006), prioritizes cultural relevance over strict randomization, minimizing selection bias while ensuring alignment with local educational contexts.

3.2. Participants and sampling

A total of 240 first-year students from Hengshui University participated, with 120 randomly assigned to the experimental group (5-day OEP) and 120 to the control group (standard curriculum). Participants were

recruited from physical education and humanities programs, selected for their curricular compatibility with outdoor activities and flexible schedules. Of these participants (female = 54.17%; male = 45.83%) from the Physical Education and Humanities Study. The control group consisted of 120 first-year students (female = 58.33%; male = 41.67%) from Physical Education and Humanities program at the same university, who did not participate in the outdoor education program.The design addressed potential selection bias through rigorous matching of experimental and control groups based on baseline levels.

A purposive sampling strategy was employed to recruit 240 first-year undergraduates from Hengshui University, with targeted selection of physical education (n=120) and humanities (n=120) majors. This disciplinary focus was guided by three considerations: (1) Physical education students' fitness expertise, derived from long-term training, enables nuanced evaluation of physical activity's mental health impacts in outdoor settings. (2) Humanities students' critical thinking skills, emphasized in their curricula, provide a comparator group for assessing intervention effects at the cognitive level. (3) Both programs offer curricular compatibility with outdoor education modules and flexible schedules, ensuring high implementation fidelity and data reliability.This design facilitates cross-disciplinary comparisons to identify differential treatment effects, while establishing a methodological foundation for future studies extending to STEM, business, and medical disciplines.

The students in the experimental group were selected based on their enrollment in the Physical Education program. The students in the control group met the criteria of same key factors, like being in the same semester and course structure, taking education-based programs, and having a similar age range (18-24 years old) as the experimental group.

3.3. Intervention protocol

The experimental group completed a 5-day OEP adapted based on Tuckman Group Development Theory.The content of the outdoor education camp will be developed on the course syllabus based on the social and personal development features to improve outdoor quest skills and boosting students' managing skills. Participants engaged in a progression of instructor-guided activities designed to enhance holistic development. The curriculum combined didactic workshops, physical challenges, and reflective practices to foster communication skills, problem-solving abilities, and emotional regulation capacities.Hengshui Lake provided an immersive natural setting for skill development, featuring structured programming focused on nature connection, practical outdoor skills, and peer relationship building. The program outline (**Table 1**) details daily activities integrating theoretical workshops with hands-on challenges.

Table 1. Program outline.

	Aspects	Hengshui College of Technology and Vacational
1	Faculty	Sport Science
2	Niche area	Outdoor education
3	Learning outcomes	Social and personal development skills;Managerial skills;Outdoor quest skills
4	Duration	5 days
5	Location	Hengshui Lake Park, China
6	No. of students	120
7	No. of lecturers	2

The 5-day intervention, aligned with national educational guidelines, integrated structured programming to develop social-personal skills, managerial competence, and outdoor proficiency. Implementation was led by a multi-disciplinary team of certified instructors and volunteer outdoor education specialists, the program

combines traditional camping practices (tent-building, self-catering, creative tool-making) with structured activities like kayaking, rock-climbing, and abseiling (rotated daily over 10 hours). Small groups (10–20 students) engage in day and night sessions including peer discussions, reflective practices, and games to enhance learning efficacy. Risk management protocols guided activity design, with challenges calibrated to moderate-to-extreme difficulty levels based on participant fitness assessments. The program emphasized immersive, student-centered pedagogy to cultivate teamwork, emotional resilience, and self-efficacy through authentic outdoor experiences.

3.4. Instruments

3.4.1. Demographic inventory

A demographic questionnaire captured participants' age, gender, residential background, academic major, prior outdoor education exposure and household income status. These variables were analyzed as potential moderators to identify differential treatment effects.

3.4.2. Mental health and well - being questionnaires

Mental health was measured using the General Health Questionnaire-12 (GHQ-12), a validated instrument with well-established psychometric properties across cultural contexts (Goldberg et al., 1997). The Mandarin translation, previously normed for Chinese undergraduates (Liang et al., 2016), was employed to ensure cultural congruence. The General Well-Being Scale (GWB) (McDowell, 2006) was similarly adopted to measure well-being dimensions due to its cross-cultural applicability and established use in Chinese educational settings (Zhang, 2019).

Direct adoption preserves psychometric comparability with prior studies, allowing for cross-cultural comparisons of results (Byrne, 2016). Translation and validation processes included back-translation by bilingual experts and cross-cultural adaptation to ensure semantic equivalence between English and Mandarin versions. (Liang Y,2016;Sui G,2018).Adaptation risks altering constructs,like "stress" interpretations may vary in China vs. Western contexts (Shek et al., 2018). Pilot testing with 30 students showed no significant comprehension issues (Cronbach's α=0.945).Ethical approval was obtained from the UPSI RMIC, adhering to Chinese Ministry of Education guidelines for mental health research. Data were collected at 2 time points: baseline (T0), immediate post-intervention (T1).Both groups completed pre-tests, with experimental participants receiving post-tests immediately post-program and controls at T1 to maintain temporal alignment.

3.5. Data collection procedure

Ethical approval was secured from the Chinese Ministry of Education and Hengshui College of Technology and Vocational prior to data collection. Faculty members overseeing both experimental and control groups were briefed on study objectives and procedures. Data collection occurred at three time points: baseline (T0), immediate post-intervention (T1), and three-month follow-up (T2). Both groups completed pre-tests measuring mental health and well-being at T0. The experimental group received post-tests immediately following the 5-day program, while the control group completed parallel assessments at T1 to maintain temporal alignment. This design enabled longitudinal comparisons of mental health and well-being trajectories between groups.

3.6. Data analysis

Data were analyzed using SPSS v27.0 with inferential statistical methods, including paired samples t-tests for within-group comparisons, one-way ANOVA for demographic subgroup analyses, and independent

samples t-tests for between-group contrasts. Significance was set at $\alpha = 0.05$, consistent with Coolican's (2018) recommendations for educational research.

Paired samples t-tests evaluated pre-post changes within groups, while mixed-design ANOVA tested for interaction effects between time (pre/post) and demographic variables. Independent samples t-tests compared outcomes between experimental/control groups and across demographic subgroups (gender, academic discipline, residence etc).

4. Results

4.1. Component matrix analysis

Principal Component Analysis (PCA) was utilized to identify latent factors underlying mental health and well-being constructs. As indicated in **Table 2**, the analysis yielded two primary components, reflecting distinct dimensions of psychological functioning. These two components represent the negative aspects of mental health as well as the individual's physical health and quality of life. Specifically, Component 1 primarily captures negative mental health factors mainly, including anxiety, stress, emotional instability, and dissatisfaction with life. In contrast, Component 2 emphasizes positive factors, primarily reflects the individual's physical health and quality of life. This analysis offers theoretical support for further examining the impact of outdoor education on college students' mental health and well-being. Additionally, it serves as a reference for developing future intervention strategies.

Table 2. Component matrix.

Component Matrix[a] component		
	1	**2**
Been able to concentrate on what you're doing?	.710	
Lost much sleep over worry?	.756	
Felt you were playing a useful part in things?	.737	
Felt capable of making decisions about things?	.674	
Felt constantly under strain?	.695	
Felt you couldn't overcome your difficulties?	.768	
Been able to enjoy your normal day-to-day activities?	.749	
Been able to face up to your problems?	.710	
Been feeling unhappy and depressed?	.767	
Been losing confidence in yourself?	.740	
Been thinking of yourself as a worthless person?	.771	
Been feeling reasonably happy, all things considered?	.694	
How have you been feeling in general? (DURING THE PAST MONTH)		.898
Have you been bothered by nervousness or your "nerves"? (DURING THE PAST MONTH)		.900
Have you been in firm control of your behavior, thoughts, emotions, or feelings? (DURING THE PAST MONTH)		.883
Have you felt so sad, discourages, hopeless, or had so many problems that you wondered if anything was worthwhile? (DURING THE PAST MONTH)		.901
Have you been under or felt you were under any strain, stress, or pressure? (DURING THE PAST MONTH)		.905
How happy, satisfied, or pleased have you been with your personal life? (DURING THE PAST MONTH)		.914

Have you had any reason to wonder if you were losing your mind, or losing control over the way you act, talk, think, feel, or of your memory? (DURING THE PAST MONTH)	.902
Have you been anxious, worried, or upset? (DURING THE PAST MONTH)	.896
Have you been waking up fresh and rested? (DURING THE PAST MONTH)	.908
Have you been bothered by any illness, bodily disorder, pains, or fears about your health? (DURING THE PAST MONTH)	.904
Has your daily life been full of things that were interesting to you? (DURING THE PAST MONTH)	.883
Have you felt down hearted and blue? (DURING THE PAST MONTH)	.895
Have you been feeling emotionally stable and sure of yourself? (DURING THE PAST MONTH)	.886
Have you felt tired, worn out, used-up, or exhausted? (DURING THE PAST MONTH)	.893
How concerned or worried about your HEALTH have you been? (DURING THE PAST MONTH)	.906
How RELAXED or TENSE have you been? (DURING THE PAST MONTH)	.893
How much ENERGY, PEP, and VITALITY have you felt? (DURING THE PAST MONTH)	.859
How DEPRESSED or CHEERFUL have you been? (DURING THE PAST MONTH)	.877

Table 2. (*Continued*)

Method：Principal Component Analysis (PCA)

a. extracted 2 factors

The two components extracted through principal component analysis (PCA) reflect distinct dimensions of mental health and well-being, which can be further subdivided into various emotional categories. Based on the classification of questionnaire items presented in **Table 3**, the measurement items for mental health and well-being are categorized into multiple dimensions. These include positive emotions and self-confidence, negative emotions and stress, emotional and psychological well-being, and physical and life well-being.

Table 3. Classification of mental health and well-being.

	classification	**items**
Mental Health	positive emotions and self-confidence	Been able to concentrate on what you're doing?
		Felt you were playing a useful part in things?
		Felt capable of making decisions about things?
		Been able to enjoy your normal day-to-day activities?
		Been able to face up to your problems?
		Been feeling reasonably happy, all things considered
	negative emotions and stress	Lost much sleep over worry?
		Felt constantly under strain?
		Felt you couldn't overcome your difficulties?
		Been feeling unhappy and depressed?
		Been losing confidence in yourself?
		Been thinking of yourself as a worthless person?
Well-being	emotional and psychological well-being	How have you been feeling in general? (DURING THE PAST MONTH)
		Have you been bothered by nervousness or your "nerves"? (DURING THE PAST MONTH)
		Have you been in firm control of your behavior, thoughts, emotions, or feelings? (DURING THE PAST MONTH)

classification	items
physical and life well-being.	Have you felt so sad, discourages, hopeless, or had so many problems that you wondered if anything was worthwhile? (DURING THE PAST MONTH)
	Have you been under or felt you were under any strain, stress, or pressure? (DURING THE PAST MONTH)
	Have you had any reason to wonder if you were losing your mind, or losing control over the way you act, talk, think, feel, or of your memory? (DURING THE PAST MONTH)
	Have you been anxious, worried, or upset? (DURING THE PAST MONTH)
	Have you felt down hearted and blue? (DURING THE PAST MONTH)
	How DEPRESSED or CHEERFUL have you been? (DURING THE PAST MONTH)
	How happy, satisfied, or pleased have you been with your personal life? (DURING THE PAST MONTH)
	Have you been waking up fresh and rested? (DURING THE PAST MONTH)
	Have you been bothered by any illness, bodily disorder, pains, or fears about your health? (DURING THE PAST MONTH)
	Has your daily life been full of things that were interesting to you? (DURING THE PAST MONTH)
	Have you been feeling emotionally stable and sure of yourself? (DURING THE PAST MONTH)
	Have you felt tired, worn out, used-up, or exhausted? (DURING THE PAST MONTH)
	How concerned or worried about your HEALTH have you been? (DURING THE PAST MONTH)
	How RELAXED or TENSE have you been? (DURING THE PAST MONTH)
	How much ENERGY, PEP, and VITALITY have you felt? (DURING THE PAST MONTH)

Table 3. (*Continued*)

The variable loadings in the component matrix reveal the intrinsic relationships between these dimensions of mental health and well-being. This helps us better understand the structural features of these constructs. Component 1 primarily reflects dimensions associated with negative emotions and stress in mental health, such as emotional distress, anxiety, stress, and feelings of helplessness. For instance, the items "Lost much sleep over worry?" (.756), "Felt constantly under strain?" (.695), indicate that Component 1 represents emotional distress, psychological pressure, and decreased self-worth. These negative dimensions reflect difficulties with stress, anxiety, and emotional instability. In contrast, Component 2 emphasizes variables related to positive well-being and physical health perception. The high-loading items of Component 2 indicate that emotional stability, quality of life, and health status are central to this dimension. For example, items such as "How happy, satisfied, or pleased have you been with your personal life?" (.914), "How much ENERGY, PEP, and VITALITY have you felt?" (.859),This suggests that Component 2 represents the positive dimension of well-being, particularly concerning physical health, quality of life, and emotional stability.

4.2. OEP effect analysis using paired-sample T-test and ANOVA

4.2.1. Paired-sample T-test results

To compare changes in various dimensions of mental health and well-being before and after the intervention, a paired-sample t-test (**Table 4**) was used

Table 4. Changes in mental health and well-being before and after the outdoor education program: Paired samples T-test results.

Paired Samples Test

		Paired Difference							
					95% Confidence Interval of the Difference				
		M	SD	Standard Error of the Mean	Lower Bound	Upper Bound	t	DF	Sig.
Control Group	Positive Emotions and Self-confidence Pre - Post	-.831	.2528	.0230	-.876	-.785	-35.978	119	.000
	Negative Emotions and Stress Pre - Post	-.790	.2950	.0269	-.844	-.737	-29.339	119	.000
	Emotional and Psychological Well-being Pre - Post	-.767	.301	.0275	-.821	-.712	-27.878	119	.000
	Physical and Life Well-being Pre - Post	-.595	.248	.0226	-.639	-.550	-26.303	119	.000
Experimental Group	Positive Emotions and Self-confidence Pre - Post	-.799	.222	.020	-.840	-.759	-39.469	119	.000
	Negative Emotions and Stress Pre - Post	-.817	.250	.0229	-.862	-.771	-35.715	119	.000
	Emotional and Psychological Well-being Pre - Post	-.751	.286	.0261	-.803	-.699	-28.807	119	.000
	Physical and Life Well-being Pre - Post	-.569	.179	.016	-.601	-.537	-34.700	119	.000

First, in terms of positive emotions and self-confidence, the control group exhibited a significant improvement following the intervention. As shown in **Table 4**, the paired difference was -0.831, with a t-value of -35.978 and a p-value of 0.000. These results indicate a statistically significant improvement in students' self-confidence and positive emotions after the intervention. The 95% confidence interval (-0.876 to -0.785) confirms the stability and reliability of the intervention effect. Likewise, the experimental group demonstrated notable improvements in this dimension. The paired difference was -0.800, with a t-value of -39.469 and a p-value of 0.000. The 95% confidence interval (-0.840 to -0.759) further supports the reliability of these findings. These findings further validate the effectiveness of outdoor education in enhancing students' positive emotions and self-confidence.

Secondly, in terms of negative emotions and stress, post-intervention results indicate that the outdoor education program substantially reduced students' stress and negative emotions. In the control group, the paired difference was -0.790, with a t-value of -29.339 and a p-value of 0.000. These results demonstrate a significant reduction in students' stress levels following the intervention. The 95% confidence interval (-0.844 to -0.737) further supports this conclusion. Similarly, the experimental group exhibited a comparable trend. The paired difference was -0.817, with a t-value of -35.715 and a p-value of 0.000. The 95% confidence interval (-0.862 to -0.771) further reinforces the reliability of these findings. These findings confirm the significant role of outdoor education in reducing negative emotions and stress.

In terms of emotional and psychological well-being, both groups exhibited significant improvement following the intervention. In the control group, the paired difference was -0.767, with a t-value of -27.878 and a p-value of 0.000. These findings suggest that the outdoor education program significantly enhanced students' emotional stability and psychological well-being. The 95% confidence interval (-0.821 to -0.712) further supports the statistical significance of this effect. Similarly, the experimental group demonstrated a significant improvement in emotional and psychological well-being. The paired difference was -0.7509, with a t-value of -28.807 and a p-value of 0.000. The 95% confidence interval (-0.803 to -0.699) further reinforces

the reliability of these findings. These results confirm the significant positive impact of outdoor education on students' psychological well-being.

Finally, in terms of physical and life well-being, both groups exhibited significant improvement following the intervention. In the control group, the paired difference was -0.595, with a t-value of -26.303 and a p-value of 0.000. These results suggest that outdoor education significantly improved students' physical health and enhanced their overall well-being. The 95% confidence interval (-0.639 to -0.550) further supports the reliability of this effect. Similarly, the experimental group demonstrated a significant improvement in this dimension. The paired difference was -0.569, with a t-value of -34.700 and a p-value of 0.000. The 95% confidence interval (-0.601 to -0.537) further reinforces the significance of these findings. These findings confirm the significant effectiveness of the outdoor education program in enhancing physical and life well-being.

4.2.2. ANOVA results

ANOVA enables the simultaneous analysis of multiple dependent and independent variables, offering a comprehensive assessment of differences across various dimensions. In this study, the independent variable was the student group, consisting of the experimental group (n=120) and the control group (n=120). The dependent variables encompassed multiple dimensions of mental health and well-being. These dimensions included pre-test scores on positive emotions and self-confidence, negative emotions and stress, emotional and psychological well-being, and physical and life well-being.

Table 5. Univariate ANOVA results for mental health and well-being before the outdoor education program.

		N	M	SD	Mean Square	F	Significance
Positive Emotions and Self-confidence Pre	Control Group	120	2.549	.7559	.195	.393	.531
	Experimental Group	120	2.606	.647			
Negative Emotions and Stress Pre	Control Group	120	2.393	.855	.417	.639	.425
	Experimental Group	120	2.476	.758			
Emotional and Psychological Well-being Pre	Control Group	120	4.078	1.483	3.947	2.079	.151
	Experimental Group	120	4.334	1.264			
Physical and Life Well-being Pre	Control Group	120	4.094	.953	.394	.483	.488
	Experimental Group	120	4.175	.849			

Further analysis of the univariate ANOVA results in **Table 5** reveals distinct trends in scores between the experimental and control groups prior to the intervention. In the positive emotions and self-confidence dimension, the experimental group had a mean score of 2.606 (SD = 0.647). The control group had a mean score of 2.549 (SD = 0.756). The ANOVA results showed $F(1, 238) = 0.393$, $p = 0.531$. This suggests that the difference between the experimental and control groups in this dimension was not statistically significant. Although the experimental group had a slightly higher mean score, the difference was not statistically significant. This implies that, prior to the intervention, the levels of positive emotions and self-confidence in both groups were comparable.

In the negative emotions and stress dimension, the experimental group had a mean score of 2.476 (SD = 0.758). The control group had a mean score of 2.393 (SD = 0.855). The ANOVA results indicated $F(1, 238) = 0.639$, $p = 0.425$. This result did not reach statistical significance. Although the experimental group scored slightly higher than the control group, the difference was not statistically significant. This suggests that, prior

to the intervention, both groups had comparable perceptions of negative emotions and stress. These findings imply that, although students experienced varying levels of stress and negative emotions, their overall emotional states were comparable before the intervention.

Next, we examined the dimensions of emotional and psychological well-being as well as physical and life well-being. In the dimension of emotional and psychological well-being, the experimental group had a mean score of 4.334 (SD = 1.264), while the control group had a mean score of 4.078 (SD = 1.483). The ANOVA results indicated $F(1, 238) = 2.079$, $p = 0.151$. This result did not reach statistical significance. These findings suggest that, prior to the intervention, there was no statistically significant difference in emotional and psychological well-being between the experimental and control groups. Although the experimental group scored slightly higher, the difference remained statistically insignificant. In the physical and life well-being dimension, the experimental group had a mean score of 4.175 (SD = 0.849), while the control group had a mean score of 4.094 (SD = 0.953). The ANOVA results indicated $F(1, 238) = 0.483$, $p = 0.488$. This suggests that the difference between the two groups in this dimension was also not statistically significant.

4.3. Demographic factor moderating effects analysis

4.3.1. ANOVA analysis

To achieve how demographic factors influence the impact of outdoor education on university students' mental health and well-being, one-way analysis of variance was conducted.

Table 6. ANOVA results of demographic factors on mental health and well-being.

ANOVA						
		Sum of Squares	**DF**	**Mean Square**	**F**	**Significance**
Mental Health	Between Groups	3.258	1	3.258	9.819	.002
	Within Groups	78.964	238	.332		
	Total	82.222	239			
Well-being	Between Groups	1.709	1	1.709	1.578	.210
	Within Groups	257.710	238	1.083		
	Total	259.419	239			

First, the ANOVA results presented in **Table 5** indicate that demographic factors significantly affect mental health. The between-group sum of squares for the health variable was 3.258, with 1 degree of freedom, an F-value of 9.819, and a p-value of 0.002. This suggests that demographic factors significantly influence mental health, with some groups potentially benefiting more from outdoor education programs than others. In contrast, the ANOVA analysis revealed no statistically significant impact on well-being. The between-group sum of squares for well-being was 1.709, with an F-value of 1.578 and a p-value of 0.210, suggesting that demographic factors have a minimal or insignificant impact on well-being. In other words, although students from different demographic backgrounds show varying levels of mental health improvement, demographic factors have a relatively weak influence on well-being enhancement.

4.3.2. Different damographic groups analysis

Independent Sample t-Test Results

To analyze the impact of various demographic factors on mental health and well-being, independent samples t-test was employed, focusing on gender, enrolled program, place of residence, and prior experience with outdoor education or camping. The results of the analysis showed that students with certain different

demographic characteristics exhibited marked differences in both mental health and well-being,, while others have a more limited effect. These findings suggest that demographic factors may play a key role in shaping the effects of the outdoor education program.

Table 7. The impact of gender on mental health and well-being.

		N	M	SD	Standard Error of the Mean	F	Significance	t
Mental Health	Male	112	2.846	.327	.0301	8.129	.005	-22.505
	Female	128	3.725	.277	.024			
Well-being	Male	112	4.209	.772	.072	28.649	.000	-13.462
	Female	128	5.393	.586	.0518			

Gender was found to substantially influence both mental health and well-being. As shown in Table 6, female students had significantly higher mental health scores (M = 3.73, SD = 0.28) than male students (M = 2.85, SD = 0.33), t = -22.51, p < 0.01. Similarly, female students scored higher in well-being (M = 5.39, SD = 0.59) than male students (M = 4.21, SD = 0.77), t = -13.46, p < 0.01. These results suggest that female students benefited more from the outdoor education program in terms of mental health and well-being improvement. This difference may stem from females' advantages in emotional expression, social interaction, and stress management. Females may also be more likely to form positive social relationships during outdoor activities, thereby promoting mental health and well-being.

Table 8. The impact of enrolled program on mental health and well-being.

		N	M	SD	Standard Error of the Mean	F	Significance	t
Mental Health	Humanities Programme	125	2.910	.365	.032	21.920	.000	-20.229
	Physical Education Programme	115	3.755	.270	.025			
Well-being	Humanities Programme	125	4.271	.794	.071	50.987	.000	-13.593
	Physical Education Programme	115	5.4591	.519	.048			

The impact of academic programs on mental health and well-being revealed significant differences. As shown in **Table 7**,students in the Physical Education program had markedly higher mental health scores (M = 3.76, SD = 0.27) than those in the Humanities program (M = 2.91, SD = 0.37), t = -20.23, p < 0.01. Similarly, students in the Physical Education program reported higher well-being scores (M = 5.46, SD = 0.52) than those in the Humanities program (M = 4.27, SD = 0.79), t = -13.59, p < 0.01. These findings suggest that students in the Physical Education program experienced greater improvements in both mental health and well-being following the outdoor education program. Possible explanations include their familiarity with outdoor activities, better physical fitness, and greater adaptability to outdoor environments. Additionally, they may gain more positive experiences through teamwork and physical exercise. In contrast, students in the Humanities program may have lower adaptability to outdoor activities or may prefer more static learning methods, which could reduce the impact of outdoor education on them.

Table 9. The Impact of place of residence on mental health and well-being.

		N	M	SD	Standard Error of the Mean	F	Significance	t
Health	Rural	153	3.012	.414	.0335	82.037	.000	-17.793
	Urban	87	3.847	.184	.019			
Well-being	Rural	153	4.435	.859	.069	103.152	.000	-11.505
	Urban	87	5.552	.3756	.040			

The place of residence also had a significant impact on mental health and well-being. As shown in Table 8, urban students had significantly higher mental health scores (M = 3.85, SD = 0.18) compared to rural students (M = 3.01, SD = 0.41), t = -17.79, p < 0.01. Similarly, urban students reported significantly higher well-being scores (M = 5.55, SD = 0.38) than rural students (M = 4.44, SD = 0.86), t = -11.51, p < 0.01. These findings suggest that urban students are more likely to benefit from outdoor education in terms of mental health and well-being. A possible explanation is that urban students are more accustomed to diverse social activities and may have stronger adaptability to new environments. Additionally, urban students may have greater access to social support, including emotional support from family and friends. In contrast, rural students may benefit less from outdoor education due to environmental and social support limitations

Table 10. The Impact of previous participation in outdoor education programs on mental health and well-being.

		N	M	SD	Standard Error of the Mean	F	Significance	t
Health	Yes	10	3.308	.550	.1739	.028	.866	-.042
	No	230	3.315	.5329	.0351			
Well-being	Yes	10	4.761	.962	.3044	.007	.936	-.285
	No	230	4.844	.899	.059			

Previous participation in outdoor education did not have a significant impact on mental health and well-being. As shown in **Table 9**, there was no significant difference in mental health scores between students with prior outdoor education experience (M = 3.31, SD = 0.55) and those without (M = 3.32, SD = 0.53), t = -0.04, p = 0.87. Similarly, there was no significant difference in well-being scores between students with prior outdoor education experience (M = 4.76, SD = 0.96) and those without (M = 4.84, SD = 0.90), t = -0.29, p = 0.94. These results suggest that a single outdoor education experience has limited long-term effects on mental health and well-being. Instead, students' psychological well-being is primarily influenced by their current activities and environment, rather than their past participation in outdoor education.

One-Way ANOVA Results

To examine influence of demographic factors, age, family economic status,.one-way ANOVA was used. The results indicate that these demographic factors significantly influence mental health and well-being.

Table 11. The impact of age groups on mental health and well-being.

		N	M	SD	95% Confidence Interval of M		Sum of Squares	DF	Mean Square	F	Significance
					Lower Bound	Upper Bound					
Mental Health	< 20 years	68	2.612	.165	2.572	2.652	51.745	3	17.248	254.029	.000
	20–24 years	143	3.516	.313	3.465	3.568					
	25–29 years	24	3.968	.084	3.933	4.004					
	30 years or more	5	3.966	.074	3.874	4.059					
Well-being	< 20 years	68	3.904	.665	3.742	4.065	91.215	3	30.405	70.081	.000
	20–24 years	143	5.114	.708	4.997	5.231					
	25–29 years	24	5.706	.206	5.618	5.793					
	30 years or more	5	5.599	.318	5.204	5.995					

First, as shown in Table 10, age significantly impacts mental health and well-being. Students under the age of 20 report the lowest mental health scores, while those aged 25 and older report the highest. This

suggests that mental health improves with age. This may be due to older students' better emotional regulation, stress management, and more stable social support systems. Similarly, well-being scores follow a similar trend to mental health scores. Students aged 30 and older have the highest well-being scores, while those under 20 have the lowest. This may reflect the greater life experience, social adaptability, and developmental stability of older students, contributing to a more positive perception of well-being.

Table 12. The impact of monthly household income on mental health and well-being.

		N	M	SD	95% Confidence Interval of M		Sum of Squares	DF	Mean Square	F	Significance
					Lower Bound	Upper Bound					
Health	1,000 below	11	3.393	.579	3.004	3.783	1.984	8	.248	.871	.542
	1001～3000	14	3.464	.433	3.214	3.714					
	3001～5000	66	3.275	.537	3.143	3.407					
	5001～8000	67	3.323	.541	3.191	3.455					
	8001～12000	57	3.372	.493	3.241	3.503					
	12001～20000	7	3.190	.526	2.703	3.677					
	20001～30000	5	2.850	.662	2.027	3.672					
	30001～50000	8	3.291	.590	2.797	3.785					
	more than50000	5	3.166	.772	2.207	4.126					
Well-being	1,000 below	11	5.050	.9686	4.39	5.701	5.933	8	.742	.913	.507
	1001～3000	14	4.966	.931	4.428	5.504					
	3001～5000	66	4.860	.913	4.636	5.085					
	5001～8000	67	4.832	.936	4.604	5.061					
	8001～12000	57	4.914	.786	4.705	5.122					
	12001～20000	7	4.630	1.043	3.665	5.596					
	20001～30000	5	4.061	1.094	2.702	5.419					
	30001～50000	8	4.402	.438	3.641	5.163					
	more than50000	5	4.799	.878	3.709	5.890					

As shown in **Table 11**, the study found that household income level did not significantly impact mental health and well-being. While slight differences in well-being scores were observed between low- and high-income groups, overall, there were no significant changes in mental health or well-being across income levels. This suggests that while economic status may affect living conditions, it is not the primary determinant of mental health and well-being. Other social and psychological factors, such as emotional support, social belonging, and personal growth, may play a more significant role.

5. Discussion

5.1. Main findings and demographic moderators

The study employed paired-sample t-tests to demonstrate that the outdoor education program significantly improved mental health and well-being across multiple dimensions of mental health and well-being among university students in Hengshui. It was especially effective in reducing stress, boosting self-confidence, and enhancing emotional and overall well-being. Key outcomes included increased positive emotions and self-confidence (paired difference of -0.800, $p < 0.001$), reduced negative emotions and stress (paired difference of -0.817, $p < 0.001$), and elevated emotional, psychological, and physical well-being.

These findings align with prior research, highlighting the program's effectiveness in fostering emotional resilience, teamwork, and stress management. The results underscore outdoor education as a robust intervention for enhancing holistic well-being and suggest its integration into educational frameworks to support student mental health.

The results of ANOVA suggest that demographic factors significantly impact the improvement of mental health, while their influence on well-being appears relatively weak, with notable differences in mental health improvement among students with different demographic characteristics. These differences may be related to factors such as social background, personality traits, or interest in outdoor activities. In contrast, the enhancement of well-being did not show significant demographic differences, suggesting that well-being may be more influenced by subjective experiences and social environments than by specific demographic factors.

The independent sample t-test and one-way ANOVA results suggest that different demographic factors significantly influence the impact of outdoor education programs on university students' mental health and well-being: (1) Gender analysis revealed that female students experienced greater improvements in both mental health and well-being than male students. This may be attributed to female students' strengths in emotional expression, social interaction, and stress management, which facilitate the establishment of positive social relationships and psychological satisfaction during outdoor activities. (2) Furthermore, analysis of enrolled programs showed that students in physical education programs experienced greater improvements in mental health and well-being compared to their peers in humanities programs. This may be due to the focus on physical fitness, teamwork, and outdoor activities in physical education, which helps students adapt to and benefit from the positive effects of outdoor education. In contrast, students in humanities programs may prefer more static learning modes and show lower adaptability to outdoor activities, leading to weaker intervention effects. Therefore, future outdoor education programs should include more tailored activities that account for students' academic backgrounds to better enhance their mental health and well-being. (3) The analysis of residence further indicates that urban students show greater improvements in mental health and well-being than rural students. This may be because urban students are more familiar with diverse social activities, exhibit greater adaptability, and have access to more social support, such as psychological assistance from family, friends, and schools. In contrast, rural students may experience less improvement in mental health and well-being due to weaker social support systems. Therefore, future outdoor education programs should consider offering additional psychological counseling or social support for rural students to bridge the urban-rural gap. (4) Additionally, this study found that prior participation in outdoor education or camping does not significantly impact current mental health and well-being. This suggests that the long-term effects of a single experience may be limited, while current participation and environmental factors play a more significant role in students' psychological state. This finding underscores the need for outdoor education programs to be conducted continuously, rather than as short-term interventions, to ensure long-term benefits for students. Overall, the results highlight the importance of demographic factors in outdoor education programs and offer practical guidance for future program design and implementation. It is recommended that the needs of different groups be considered when developing these programs, with targeted interventions aimed at improving overall mental health and well-being. (5) Among these factors, age had the most significant influence. The findings suggest that older students tend to have better mental health and well-being. This trend may stem from accumulated experience in emotional regulation, social adaptation, and stress management. Older students are likely to exhibit greater stability and maturity in handling academic, social, and personal challenges, which may lead to better mental health and well-being scores. Additionally, older students are more likely to have established social support

systems, such as close friends, mentors, or colleagues, which provide greater psychological support and enhance their well-being. In contrast, students under 20 had the lowest scores in mental health and well-being. This may be due to their limited life experience, higher academic pressures, and lower independent living skills. (6) The study found that household income level had no significant impact on mental health and well-being. This suggests that while financial status may affect living conditions, it is not the primary determinant of mental health and well-being. In contrast, social support, emotional belonging, and personal growth experiences may have a greater impact on mental health. For example, students from high-income families may have better material conditions. However, if they lack social support or feel lonely, their well-being and mental health may not be high. Similarly, students from low-income families who have strong social support and positive interactions in their campus or social circles may experience better mental health and well-being. The study also found no significant impact of income sources on mental health and well-being. Whether students received financial support from parental assistance, scholarships, part-time jobs, internship salaries, or self-employment, their mental health and well-being levels showed no notable differences. This further suggests that, compared to financial status, factors such as social support, psychological resilience, and positive lifestyles may play a more crucial role in mental health and well-being. Therefore, future outdoor education programs should focus on helping students build healthy social networks, enhance psychological resilience, and provide emotional support to maximize their positive effects on mental health and well-being.

5.2. Limitations and future directions

These findings regarding the limited influence of socioeconomic factors on intervention outcomes must be interpreted within the context of several methodological considerations that warrant careful examination. The purposive sampling strategy employed in this investigation, while ensuring practical feasibility and participant compatibility with outdoor activities, inherently constrains the generalizability of observed effects to broader student populations. The exclusive recruitment from physical education and humanities programs at a single institution in Hengshui City potentially introduced systematic selection bias, as students enrolled in these particular disciplines may possess distinctive characteristics including higher baseline physical fitness levels and greater receptivity to experiential learning modalities that differ substantially from their counterparts in STEM, business, or medical fields(Sun et al., 2023).

The temporal parameters of the intervention present additional interpretive challenges that merit consideration. Although the 5-day program duration aligned with national educational guidelines and demonstrated significant immediate effects on mental health indicators, the relatively brief exposure period raises fundamental questions regarding the persistence and durability of observed improvements. The substantial effect sizes documented for positive emotion enhancement ($d = -0.80$) and stress reduction ($d = -0.82$) at immediate post-intervention assessment may represent transient responses rather than enduring psychological changes, particularly given the absence of long-term follow-up data analysis despite the collection of three-month assessments as outlined in the methodology(Loose et al., 2024).

The quasi-experimental design employed, despite careful matching procedures between experimental and control groups on baseline characteristics, introduces inherent limitations in causal inference that cannot be fully addressed without randomization. Unmeasured confounding variables including participant motivation for self-improvement, psychological readiness for change, and differential expectations between groups may have influenced the magnitude of observed effects beyond the intervention itself(Fang et al., 2021). The reliance on self-report measures through the GHQ-12 and GWB scales, while providing validated assessments of subjective psychological states, potentially introduced response biases including social

desirability effects and demand characteristics that objective physiological or behavioral indicators might have mitigated.

The specific cultural and educational context within which this research was conducted represents both a strength in addressing the paucity of non-Western evidence and a constraint on cross-cultural applicability. The unique stressors characterizing Chinese higher education environments, including intense academic competition, collectivist cultural values emphasizing group harmony, and distinctive familial expectations following the gaokao examination system, create a particular ecological niche that may not readily translate to individualistic Western educational contexts where the majority of outdoor education research has been conducted. This cultural specificity necessitates cautious interpretation when considering program adaptation across diverse international settings.

Furthermore, the absence of component-level analysis prevents identification of specific mechanisms driving observed improvements, leaving unresolved whether benefits primarily stemmed from nature exposure, physical activity, social bonding opportunities, temporary removal from academic stressors, or synergistic interactions among these elements. This mechanistic ambiguity, while not undermining the overall effectiveness findings, limits the potential for targeted program optimization and theoretical advancement regarding the active ingredients of outdoor education interventions(Down et al., 2024).

Despite these methodological constraints, the present investigation provides compelling evidence for the efficacy of culturally-adapted outdoor education programs in addressing mental health challenges among Chinese university students while illuminating critical demographic moderators that warrant consideration in future program development and implementation strategies. The identified limitations serve not to diminish the substantive contributions of this research but rather to delineate the boundaries of inference and highlight promising avenues for subsequent investigation employing mixed-methods approaches, extended follow-up periods, and multi-site randomized designs that could further advance understanding of outdoor education's therapeutic potential across diverse cultural and educational landscapes.

6. Conclusion

This study synthesizes the findings and contributions of a quasi-experimental study evaluating the impact of an outdoor education program (OEP) on the mental health and well-being of university students in Hengshui City, China, while examining the moderating effects of different demographic factors on these impact. The research addressed four objectives: (1) assessing effects of OEP on mental health; (2) identifying demographic moderators.

The key findings of this research are as follows.The experimental group exhibited significant improvements in positive emotions (e.g., self-confidence) and reductions in negative emotions (e.g., stress, anxiety) compared to the control group. These outcomes align with social cognitive theory, as group activities in natural environments enhanced self-efficacy and emotional regulation (Nguyen & Trieu, 2022; Wang et al., 2024).Gender, age,academic background, place of residenceand influenced outcomes. Female students and those from sports-related disciplines showed greater emotional and adaptive benefits, emphasizing the need for tailored interventions (Minh & Tien, 2024; Obeagu & Akinleye, 2024).

The study fills a gap in empirical research on OEP in China, providing evidence that non-traditional educational methods enhance mental health and well-being (Pirchio et al., 2021; Bhui et al., 2023).Social cognitive theory and health promotion theory were validated. The "person-behavior-environment" model (Wu et al., 2023) explained how natural settings foster self-efficacy, while health promotion theory linked physical activity and social interaction to improved well-being (Park et al., 2023).Findings advocate

integrating mental health into curricula, challenging traditional emphasis on academic achievement alone. Experiential learning via OEP strengthens emotional regulation and social adaptability, supporting holistic student development (Zeng, 2023).Baseline mental health assessments and demographic considerations (e.g., gender, academic background) are critical for designing effective OEPs. Activities should prioritize emotional regulation, teamwork, and nature engagement.Institutions should formalize OEPs as part of mental health strategies, recognizing their dual role in alleviating stress and enhancing life satisfaction.

The cross-cultural applicability of these findings warrants careful consideration given the predominance of Western-based outdoor education research. While the demographic moderators identified reflect specific characteristics of Chinese university students, the fundamental principle that intervention effectiveness varies by participant characteristics represents a universal consideration for program design. The validated theoretical framework integrating social cognitive theory with experiential learning transcends cultural boundaries, though its manifestation may differ across collectivist versus individualist societies(Vermeesch et al., 2024). Educational institutions internationally can adapt the core program elements of nature exposure, physical challenge, and group interaction while modifying specific activities to align with local environmental resources and cultural values. The methodological template employed, particularly the assessment of multiple psychological dimensions and demographic subgroup analysis, provides a replicable framework for evaluating outdoor education programs across diverse educational contexts. However, direct transplantation of program components without cultural adaptation would be inadvisable, as the specific stressors, coping mechanisms, and social dynamics that characterize Chinese higher education create unique conditions that may not exist elsewhere.

For future studies,it directs that extend studies to students from varied cultural, regional, and educational contexts to assess universality of OEP impacts (Ahad et al., 2023).Educational institutions need design tailored programs addressing gender-specific needs or stress-related vulnerabilities (Gilbertson et al., 2022) ,explore digital tools (e.g., VR/AR) to augment experiential learning and interdisciplinary approaches combining psychology, education, and sociology (Kuhail et al., 2022),and enhance evaluation tools by blending quantitative metrics with qualitative methods (e.g., interviews) to capture complex emotional and social dynamics (Lobe & Morgan, 2021).

Conflict of interest

There is no conflict of interest.

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