

Digital Empowerment of Traditional Fitness Education The Application of Baduanjin in Promoting College Students' Sleep Quality and Cervical Health

Yue Wei

Abstract – In the era of artificial intelligence and digitalization, higher education is undergoing significant changes in teaching methods, health promotion, and student support services. Within physical education, digital tools provide new opportunities for monitoring health status, optimizing exercise intervention, and improving the effectiveness of traditional fitness education. Against this background, Baduanjin, as a traditional Chinese mind-body exercise, shows promising value in university health education. This study focuses on the application of Baduanjin in college physical education and health promotion, with particular attention to sleep quality and cervical sub-health among university students. The research explores how traditional exercise can be integrated with digital educational thinking to support students' physical and mental well-being. By combining questionnaire-based assessment, health evaluation, and structured exercise intervention, the study examines the potential of Baduanjin as an accessible, low-cost, and sustainable approach for campus health management. The study is expected to demonstrate that regular Baduanjin practice may help relieve cervical discomfort, improve sleep quality, and enhance students' health awareness and self-management ability. More importantly, the research highlights the educational significance of combining traditional sports culture with digital-age health education concepts. It provides a practical reference for universities seeking innovative pathways to integrate physical education, health intervention, and digital transformation. The findings may contribute to the modernization of sports education and the promotion of healthy lifestyles among college students.

Keywords – Baduanjin; sleep quality; cervical sub-health; college students; physical education; digital health education

I. INTRODUCTION

Higher education is experiencing rapid digital transformation. Learning platforms, wearable devices, online health assessment, and data-informed student services are changing the way universities organize teaching and health promotion. In physical education, this change has encouraged teachers to move beyond a single focus on skill instruction and to consider how exercise courses can help students monitor their health, develop healthy routines, and improve daily functioning.

Among the health concerns faced by university students, poor sleep quality and cervical sub-health are particularly relevant. University students often experience academic pressure, irregular schedules, prolonged sitting, and extensive use of smartphones and computers. These factors may contribute to delayed sleep onset, reduced sleep efficiency, daytime fatigue, neck stiffness, shoulder discomfort, and reduced cervical mobility. When these

problems persist, they may affect learning efficiency, emotional stability, physical comfort, and long-term health.

Baduanjin is a traditional Chinese mind-body exercise consisting of eight coordinated movements. It combines slow movement, breathing regulation, posture adjustment, and mental concentration. Unlike high-intensity exercise, Baduanjin is moderate, safe, and easy to organize in ordinary university spaces. These features make it suitable for students with different fitness levels and for universities seeking low-cost, sustainable approaches to health education.

In the digital age, the value of Baduanjin should not be understood as a rejection of technology. On the contrary, traditional exercise can be strengthened by modern educational thinking. Questionnaire-based screening, online learning resources, video-guided practice, attendance recording, and periodic health evaluation can help teachers monitor participation and support student self-management. Therefore, Baduanjin provides a useful case for exploring how traditional sports culture can be integrated with digital-age physical education.

II. PROBLEM STATEMENT

Although existing research has examined sleep problems and cervical discomfort among college students, these two issues are often studied separately. Sleep research usually emphasizes psychological stress, sleep habits, and lifestyle behaviours, whereas cervical health research tends to focus on posture, screen exposure, and sedentary behaviour. In real university life, however, these problems frequently appear together. Students who use digital devices for long hours may experience both neck discomfort and poor sleep, and these conditions may influence each other.

There is also a practical gap in current intervention research. Many exercise intervention studies focus on single outcomes, such as sleep improvement or musculoskeletal pain relief. Fewer studies evaluate whether one structured traditional exercise program can improve both sleep quality and cervical sub-health in the same university population. This limits the ability of universities to design efficient health promotion programs that address students' interconnected needs.

In addition, many studies rely only on questionnaire scores and give limited attention to students' lived experiences. Quantitative data are important for identifying statistical relationships, but interviews can explain how students perceive bodily comfort, relaxation, sleep changes, and adherence difficulties during the intervention. A mixed-methods design can therefore provide a more complete understanding of the role of Baduanjin in campus health promotion.

Based on these gaps, this study examines whether a semester-long Baduanjin exercise intervention can improve sleep quality and cervical sub-health among students at Jilin Normal University. It also considers how digital-age health education concepts can support traditional exercise through structured assessment, feedback, and self-management.

III. LITERATURE REVIEW

Sleep quality has become an important issue in university health research. The Pittsburgh Sleep Quality Index is widely used to evaluate sleep duration, sleep latency, sleep efficiency, sleep disturbances, and daytime dysfunction. Studies on college students have shown that poor sleep is associated with academic stress, irregular routines, physical inactivity, and excessive screen exposure. These findings suggest that improving sleep quality requires more than simple advice; it requires behavioural intervention that students can maintain in daily life.

Cervical sub-health refers to a functional condition characterized by neck discomfort, stiffness, reduced flexibility, and early musculoskeletal imbalance before the development of clinically diagnosed cervical disease. Among university students, long-term desk study and forward-head posture during smartphone use can increase mechanical stress on the cervical region. If these symptoms are not addressed, students may experience persistent discomfort and reduced quality of life.

Baduanjin has been increasingly examined as a mind-body exercise intervention. Its slow movements and breathing coordination may reduce psychological tension, while its stretching and posture-control components may improve flexibility and muscular endurance in the neck and shoulder region. Previous studies have reported that Baduanjin practice may improve psychological well-being, sleep-related outcomes, and musculoskeletal function. These findings support its potential as a non-pharmacological intervention for university students.

From an educational perspective, Baduanjin is also valuable because it carries traditional Chinese sports culture. Its application in university physical education can connect health behaviour, cultural identity, and lifelong exercise habits. In the context of digital transformation, Baduanjin can be taught through blended methods: face-to-face demonstration can ensure movement quality, while video review, online questionnaires, and periodic feedback can support independent practice.

IV. METHOD

This study used a mixed-methods design to examine the influence of Baduanjin exercise on sleep quality and cervical sub-health. Quantitative data were collected through structured questionnaires, and qualitative information was obtained through interviews. The design allowed the research to test statistical relationships while also exploring students' subjective experiences after sustained practice.

The participants were students from Jilin Normal University. A total of 435 questionnaires were distributed through an online platform, and 422 valid questionnaires were retained after data screening. The effective response rate was 97.01%. The sample included 185 male students and

237 female students. In terms of grade level, 113 were freshmen, 137 were sophomores, 105 were juniors, and 67 were seniors. The sample also showed varied screen-use patterns and exercise habits, which reflected the diversity of ordinary university students.

The intervention was organized as a semester-long Baduanjin exercise program. Students were guided to learn and practice the complete routine with attention to movement accuracy, breathing coordination, safety, and adherence. The intervention emphasized moderate intensity and continuity rather than competitive performance. Digital educational support was reflected in online questionnaire collection, structured health evaluation, and the encouragement of self-monitoring during practice.

The main variables were Baduanjin exercise participation, sleep quality, and cervical sub-health. Baduanjin exercise was assessed through participation and adherence, intensity adaptation, enjoyment and motivation, and fidelity and safety. Sleep quality was assessed through indicators related to sleep onset, sleep maintenance, sleep efficiency, and daytime functioning. Cervical sub-health was assessed through self-reported cervical discomfort and functional status. Quantitative data were analyzed using descriptive statistics, reliability and validity tests, and partial least squares structural equation modelling. Interview materials were used to interpret perceived changes in sleep, neck comfort, relaxation, and health awareness.

TABLE I: BASIC SAMPLE INFORMATION

Basic information	Options	Percent
Gender	Male	43.8
	Female	56.2
Grade	Freshman year	26.8
	Sophomore year	32.5
	Junior year	24.9
	Senior year	15.9
Avg. daily screen time	Less than 2 hours	11.1
	2-4 hours	30.1
	4-6 hours	42.2
	More than 6 hours	16.6
Exercise habit	Yes	58.5
	No	41.5

V. FINDINGS

The data screening results showed that the final dataset was suitable for statistical analysis. The 422 valid responses contained no missing values because all questionnaire items were set as mandatory. The data were also examined for abnormal response patterns and outliers before descriptive and structural analyses were conducted.

Descriptive results indicated that students had substantial exposure to digital devices. Among the respondents, 47 students reported less than two hours of daily screen time outside formal coursework, 127 reported two to four hours, 178 reported four to six hours, and 70 reported more than six hours. This distribution shows that prolonged screen exposure is common among the sample and supports the relevance of cervical health intervention in the university context.

The measurement model demonstrated acceptable reliability and validity. Cronbach's alpha values for the first-order constructs ranged from 0.814 to 0.884, and composite reliability values ranged from 0.890 to 0.920. Average variance extracted values ranged from 0.698 to 0.742. For the second-order constructs, reliability and validity indicators also exceeded recommended thresholds. These results supported the adequacy of the measurement model for subsequent structural analysis.

The structural model showed significant effects of Baduanjin exercise on both cervical sub-health and sleep quality. The path from Baduanjin exercise to cervical sub-health was significant ($\beta = -0.417$, $t = 8.747$, $p < 0.001$), indicating that stronger participation in Baduanjin was associated with lower cervical sub-health symptoms. The path from Baduanjin exercise to sleep quality was also significant ($\beta = 0.353$, $t = 6.989$, $p < 0.001$), suggesting that Baduanjin practice was positively associated with improved sleep quality. The R-square value was 0.125 for sleep quality and 0.174 for cervical sub-health, indicating meaningful but modest explanatory power in a behavioural health context.

Qualitative evidence supported the quantitative findings. Students commonly described Baduanjin as gentle, acceptable, and easy to continue. Some participants reported that the breathing rhythm and slow movements helped them relax after study, while others noted reduced neck-shoulder stiffness after repeated practice. Students also became more aware of posture, screen-use habits, and the connection between exercise and sleep. These subjective accounts help explain why a traditional exercise intervention may produce both physical and psychological benefits.

TABLE II: MAIN STRUCTURAL MODEL RESULTS

Path	β	t value	p value	Decision
Baduanjin Exercise -> Cervical Sub-Health	-0.417	8.747	<0.001	Supported
Baduanjin Exercise -> Sleep Quality	0.353	6.989	<0.001	Supported

VI. DISCUSSION

The findings indicate that Baduanjin has practical value for university health promotion. The significant relationship between Baduanjin exercise and sleep quality suggests that a structured mind-body exercise routine may help students regulate tension and develop a calmer pre-sleep state. Because sleep quality is influenced by many factors, the modest explanatory power of the model is reasonable. Exercise alone cannot solve all sleep problems, but it can serve as an accessible component of a broader campus health strategy.

The significant effect on cervical sub-health is also important. Students spend long hours in reading, writing, and digital-device use, and these behaviours often place pressure on the neck and shoulder region. Baduanjin includes stretching, posture adjustment, slow rotation, and coordinated upper-limb movements, which may help relieve muscular stiffness and improve body awareness. Its low

intensity makes it suitable for students who may not be willing or able to participate in vigorous exercise.

The study also shows that traditional exercise and digital education can be combined. Digitalization should not be limited to advanced artificial intelligence systems or expensive equipment. For ordinary university physical education, practical digital support may include online health screening, video resources, attendance and adherence records, feedback forms, and periodic self-assessment. These tools can help teachers monitor the intervention and help students understand their own health changes.

At the same time, the educational meaning of Baduanjin should be emphasized. It is not only a health intervention but also a carrier of traditional sports culture. When students learn Baduanjin, they engage with movement, breathing, concentration, and cultural knowledge. This integrated value is consistent with the modern mission of physical education, which includes health promotion, cultural education, and lifelong exercise habit formation.

Several limitations should be considered. First, the study was conducted within one university, so the findings should be generalized cautiously. Second, the main outcomes relied on self-reported instruments, which may be affected by subjective perception. Third, although the semester-long intervention can show short-term change, longer follow-up is needed to determine whether students maintain Baduanjin practice after the course. Future studies may add objective sleep monitoring, cervical range-of-motion assessment, or randomized control group designs to strengthen causal inference.

VII. CONCLUSION

This study examined the role of Baduanjin exercise in improving sleep quality and cervical sub-health among college students in a digital-age physical education context. The results showed that Baduanjin exercise significantly predicted better sleep quality and lower cervical sub-health symptoms. Interview evidence further indicated that students perceived improvements in relaxation, neck comfort, posture awareness, and health self-management.

The main conclusion is that Baduanjin can be used as a feasible, low-cost, culturally meaningful, and sustainable intervention in university physical education. Its value lies not only in physical movement but also in the integration of traditional sports culture, health education, and structured digital-age assessment. Universities seeking practical pathways for student health promotion may consider incorporating Baduanjin into physical education courses, campus wellness programs, and blended health management models.

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