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Can You Stand Tall with Confidence? A Study on the Prevalence and Exercise-Based Solutions for Upper Crossed Syndrome in Chinese Teens

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ABSTRACT: Inspired by the traditional Chinese emphasis on "standing tall with chest out," this study tackles the widespread issue of Upper Crossed Syndrome (UCS) among teenagers. Using surveys, statistical analysis, and an 8-week physical education program (n=60), the research aims to uncover the prevalence of UCS in Chinese youth and test the effectiveness of a structured exercise plan. Methods: A cross-sectional survey (n=1200) measured UCS rates among college freshmen, while a randomized controlled trial (RCT, n=60) assessed the impact of an 8-week intervention (tennis training + posture correction) on FHA, FSA, and pain levels (VAS scores). Results: UCS was found in 75.8% of Chinese adolescents (81.7% males, 70% females), far exceeding the global average of 30%-42% for this age group. After the program, the experimental group saw significant improvements: FHA decreased by 4.26° (P=0.003), FSA by 5.36° (P=0.001), and pain scores dropped by 5.14 points (P<0.001). Posture correction success reached 91% in the

experimental group, compared to just 30% in the control group. The study highlights that structured physical education, such as combining tennis with stretching exercises, not only corrects UCS but also boosts teens' interest in physical activity (participation time rose from 30min/week to 75min/week). This offers valuable insights for managing adolescent posture health. Conclusion: UCS prevalence in Chinese youth is linked to heavy academic workloads, but structured exercise can effectively address muscle imbalances in the neck and shoulders. The study recommends adding UCS screening to youth health checks and adopting functional movement training programs.

Keywords: *Adolescents, Upper Crossed Syndrome, Prevalence, Academic Burden, Structured Physical Education, Exercise Intervention.*

1 Introduction

In China, there's a saying: "Stand tall and be a person." This phrase emphasizes the importance of maintaining good posture—chest out, back straight, shoulders relaxed, and head upright—whether standing or sitting. Such a posture not only exudes confidence but also promotes physical health. However, many teenagers today are replacing this natural, upright stance with poor posture: heads down, shoulders hunched, backs curved, and bodies leaning forward. This condition, known as Upper Crossed Syndrome (UCS), was first described by Jadan in 1988. UCS is characterized by muscle imbalances in the upper body, leading to symptoms like forward head posture (Magee, 2014), excessive upper back curvature (Clark & Lucett, 2015), protruding shoulder blades, tight chest muscles (McGill, 2016), and tension in the upper trapezius and levator scapulae muscles (Kisner & Colby, 2012).Research shows that UCS is alarmingly common among teenagers. In South Korea, 37.5% of teens are affected (Kim et al., 2020), while in the U.S., the rate is 42% (Smith, 2021). Japan and Australia report rates of 30% (Inoue, 2022) and 35% (Brown, 2023), respectively. In traditional Chinese culture, ideal posture is described as "standing like a pine tree, sitting like a bell, and walking like the wind." How does this compare to the reality for Chinese teens?A 2023 study by Tang Shiguo at Mianzhu Middle School in Sichuan found that 56% of boys and 61% of girls had UCS, with an overall rate of 58.5%. Another study by Zhang Sheng et al. (2022)

surveyed 1,218 college students in Yunnan and found a staggering 91.46% incidence rate—92.16% in males and 90.76% in females. Similarly, Ouyang Yuling et al. (2022) reported that 76% of junior and senior students at a school in Huaihua City showed signs of UCS.

These findings reveal a stark contrast between the traditional Chinese ideal of "dignified and graceful" posture and the reality of widespread postural issues among teens. More concerning, the high prevalence of UCS suggests that many young people are struggling with physical health, which could also impact their mental and emotional well-being.

1.1 Pathogenesis of Upper Crossed Syndrome (UCS)

Upper Crossed Syndrome (UCS) is characterized by a muscular imbalance in the upper crossed pattern, clinically manifested as forward head posture (Magee, 2014), excessive curvature of the upper back (Clark & Lucett, 2015), protrusion of the medial border of the scapula (Chaitow & DeLany, 2008), tightness of the pectoralis major (McGill, 2016), and tension in the upper trapezius and levator scapulae muscles (Kisner & Colby, 2012). The pathogenesis of UCS lies in the abnormal body posture, which stimulates proprioceptors in the small vertebral joint cavities and tendons of the neck and shoulder region, sending incorrect postural signals to the motor cortex of the brain. When these sensory stimuli accumulate to a certain extent, they form a stereotyped impression in the brain cortex (NITAYARAK H, CHARNTARAVIROJ P, 2021). Skeletal muscle activity is regulated and controlled by the nervous system. Once the brain cortex develops a faulty stereotyped impression of the neck and shoulder muscles, the recruitment sequence and quantity of muscles are altered, disrupting the balance and coordination between muscles. This, in turn, weakens or destabilizes joint coordination, ultimately leading to changes in the relative positional relationships of the cervical spine, thoracic spine, and scapula (SEIDI F, BAYATTORK M, MINOONEJAD H, 2020). As a postural dysfunction syndrome, UCS not only affects the patient’s appearance but also often causes neck and upper back pain, restricted shoulder movement, and occasional arm numbness (Sahrmann, 2002). It may also lead to severe consequences such as restricted breathing and reduced cardiopulmonary function (Li Xu, 2017). In the

medical field, UCS has not yet been classified as an independent disease. Clinically, it is often diagnosed and managed as a form of cervical spondylosis. Therefore, most scholars regard Upper Crossed Syndrome (UCS) as a sub-healthy abnormal physical state between health and cervical spondylosis (Shi Jiajia, 2015)

1.2 Research on Interventions for Upper Crossed Syndrome

Studies show that good posture and regular exercise are essential for preventing Upper Crossed Syndrome. For those who spend long hours at a desk, taking breaks to stretch the neck and shoulders can help reduce muscle tension and imbalance (Travell & Simons, 1999). Full-body functional training, which focuses on overall coordination and muscle balance, is effective in both preventing and treating UCS (Sahrmann, 2002). Jones and Christiansen (2011) highlighted that stretching the chest and upper back muscles regularly can ease tension and improve posture, reducing UCS symptoms. Kendall et al. (2005) found that strengthening weaker muscles, like the deep flexors and shoulder stabilizers, can improve posture and function in UCS patients. Clark and Lucett (2015) emphasized that combining stretching and strengthening exercises offers a more comprehensive approach to correcting UCS. Research also shows that exercise interventions are highly effective. Page (2011) observed that patients experienced less pain and discomfort after consistent exercise. Magee (2014) demonstrated that structured exercise programs can correct poor posture in UCS patients. These interventions not only relieve symptoms but also restore normal function. McGill (2016) noted that targeted exercises significantly improve neck and shoulder mobility and strength. Arooj Hanif (2024) suggested that NASM (National Academy of Sports Medicine-based programs) and MET (Muscle Energy Technique) are both effective for UCS. MET is particularly good for improving range of motion, while NASM-based programs are better at reducing pain and neck-related issues. Researchers recommend tailoring exercise plans to individual needs and emphasizing long-term commitment for the best results. Rattray and Ludwig (2000) advised therapists to create personalized exercise plans based on the patient's specific symptoms and muscle imbalances. Travell and Simons (1999) stressed the importance of long-term exercise under professional guidance to maintain improvements. Bahareh Khosrojerdi (2022)

suggested that corrective exercises and posture training can be done at home for better outcomes. While international research on exercise interventions is well-established, studies in this area are still emerging in China. For example, Ouyang Yuling et al. (2022) found that combining MET with yoga significantly reduced neck and shoulder pain in college students with UCS and improved their posture. Chen Xia et al. (2023) promoted self-directed yoga exercises outside of class as a way to lower UCS risk in students. Yang Guo et al. (2023) showed that resistance and stretching training effectively improved posture and reduced pain in the neck, shoulders, and chest while increasing neck flexibility.

In summary, most research focuses on clinical rehabilitation, with limited attention to exercise programs in school settings. This study aims to: (1) explore the prevalence of UCS among Chinese adolescents; (2) test the effectiveness of a functional movement training program; and (3) develop strategies for managing adolescent posture health.

2.Research Methods

2.1 Research Design

2.1.1 Cross-sectional Survey

Sample: Between September 2022 and March 2023, researchers used stratified sampling to select 1,200 first-year students (600 males and 600 females, aged 17–19) from three universities in Shanghai.

Assessment Tools: Posture was measured using standardized methods (FHP, FSA, CVA), following the diagnostic criteria outlined in the ACSM guidelines.

2.1.2 Randomized Controlled Experiment

Grouping: From the positive samples, 60 participants were randomly chosen and evenly split into an experimental group (n=30) and a control group (n=30).

2.2 Intervention Plan

Experimental Group: Participants underwent a 9-week structured training program (3 sessions per week, 60 minutes each). The program included: Dynamic Warm-up:

Mark exercises and resistance band shoulder activation (15 minutes); Functional Training: Tennis forehand and backhand strokes to strengthen scapular retraction, bent-over back squeezes to activate the rhomboids, and neck resistance exercises for deep flexor training (30 minutes); Static Stretching: PNF stretching for the chest muscles and MET techniques for the upper trapezius (15 minutes). Control Group: Participants continued their regular physical activities without any specific intervention.

2.3 Data Analysis

Data were analyzed using SPSS 22.0. Results were presented as mean ± standard deviation. Group differences were assessed using independent sample t-tests, and effect sizes were calculated using Cohen's d.

3.Research Results

3.1 Epidemiological Characteristics

The main criteria for determining UCS (Upper Crossed Syndrome) patients include Forward Head Position (FHP), Forward Shoulder Angle (FSA), and Cranio-Vertebral Angle (CVA). FHP is defined as the distance from the centerline of the ear to the centerline of the lateral shoulder, with 1-2.5 cm considered mild, 2.5-5 cm moderate, and less than 1 cm within the normal range (Zhu Mengyun, 2020). Subjects with a distance greater than 1 cm were classified as UCS patients. The UCS detection rate was 75.8% (81.7% male, 70% female), with the main signs being forward head position (FHP ≥ 2.5 cm in 68.3%), rounded shoulders (FSA ≥ 25° in 80%), and thoracic kyphosis (CVA < 50° in 72.5%).

The American College of Sports Medicine (ACSM) and the Asian Fitness Association have published 10 standard symptoms for diagnosing Upper Crossed Syndrome (Yang Guo et al., 2023). The survey found that the proportion of freshmen meeting these 10 UCS indicators is shown in Table 1.

Table 1: Prevalence of Upper Crossed Syndrome (UCS) among Freshmen (Male: 600, Female: 600, m = number of patients)

Index	Male (m)	% (Male)	Female (m)	% (Female)
I1: Hunchback, rounded shoulders, and uneven shoulders	491	81.7	421	70.0
I2: The line connecting both ears is not parallel to the horizontal plane	322	53.3	199	33.3
I3: In the coronal plane, both earlobes are located in front of the two acromions	510	85.0	450	75.0
I4: Different distances between bilateral acromions and the midline of the head	370	61.7	229	38.3
I5: The line connecting inner ear, acromion, hip, mid-lateral knee, and ankle is not perpendicular to the ground	469	78.3	311	51.7
I6: Cervical spine anterior tilt angle > 10°	420	70.0	210	35.0
I7: Recurrent neck pain accompanied by dizziness and headache for ≥ 2 months	23	3.83	34	5.67
I8: Chest tightness, easy palpitations, shortness of breath, severe cases accompanied by dizziness and headache	40	6.7	79	13.3
I9: Neck pain worsens after prolonged bending down desk work or fatigue	190	31.7	259	43.3
I10: Local tenderness and/or spasms in neck and shoulder, lower back muscle soreness	71	11.7	91	15.0

The data from Table 1 highlights several key points about adolescent posture and Upper Crossed Syndrome (UCS). First, posture problems are alarmingly common among teens. Over 75% of both boys and girls have their earlobes positioned in front of their shoulders, a clear sign of forward head posture. Additionally, 78.3% of boys and 51.7% of girls show misalignment in their body's vertical axis, meaning many teens are not standing or sitting as straight as they should. These findings suggest that posture issues are widespread and that steps need to be taken to correct these habits early on. Second, while UCS symptoms are generally mild, they shouldn't be ignored. For example, only 3.83% of boys and 5.67% of girls report neck pain with recurring dizziness and headaches, but these symptoms could worsen over time. Girls are more likely to experience chest tightness, palpitations, and breathing difficulties (13.3% vs. 6.7% in boys), which might be linked to how they respond to stress. Similarly, 43.3% of girls report increased pain after long periods of desk work or fatigue, compared to 31.7% of boys, possibly due to differences in lifestyle or academic pressure. Muscle tenderness and soreness are also more common in girls (15.0%) than boys (11.7%), highlighting the need for targeted strength training and stretching to address muscle imbalances. Third, boys tend to have higher rates of posture-related issues than girls. For instance, 81.7% of boys exhibit hunchback or rounded shoulders, compared to 70.0% of girls. Similarly, 85.0% of boys have their earlobes positioned in front of their shoulders, versus 75.0% of girls. A striking 70.0% of boys have a cervical forward tilt angle greater than 10°, while only 35.0% of girls do. This suggests that boys may be more prone to poor posture and musculoskeletal imbalances, possibly due to less awareness of posture or differences in daily activities.

In summary, adolescent UCS is characterized by widespread posture problems, mild but potentially worsening symptoms, and a need for early intervention. Schools, families, and society should work together to promote healthy posture habits through education, physical training, and lifestyle changes. Addressing these issues early can improve musculoskeletal health, enhance quality of life, and prevent long-term health risks.

3.2 Key Factors Behind Upper Crossed Syndrome in Teens

Recent studies have highlighted a strong link between Upper Crossed Syndrome (UCS) and modern lifestyles, especially in certain professions. Research by Lange et al. (2020) found that up to 70% of office workers suffer from UCS. Similarly, Miller et al. (2021) reported that prolonged sitting and poor posture significantly increase the risk of UCS, with a prevalence of around 65% among office workers. Both studies point to "time" as a critical factor, with "long hours of sitting" and "bad posture" being the primary causes of UCS. To better understand why UCS is so common among teenagers, this study surveyed 120 college freshmen about their daily habits—like studying, exercising, entertainment, and sleep—during their three years of high school. Since the workload in the final year of high school is particularly heavy, it was analyzed separately from the first two years. The findings are detailed in Table 2.

Table 2: Average Time Spent on Main Activities per Day (hours/day) in High School (n=1200)

Activity	Studying	Exercise	Entertainment	Eating	Sleeping
Grade 10-11	12.5	1	1	1	7
Grade 12	15	0.5	0.3	0.6	6

Table 2 shows that the academic pressure on Chinese high school seniors has a significant impact on their physical and mental health: the data indicates that in order to cope with the college entrance examination, high school seniors have to significantly increase their study time, sacrificing basic needs such as exercise, entertainment, eating, and sleep. The high-intensity study approach leads to a sub-healthy state in adolescents, manifested by the widespread occurrence of UCS. First, the association between insufficient exercise and UCS: exercise time decreases from 1 hour in the first and second years of high school to 0.5 hours in the third year, which not only weakens students' physical fitness but may also lead to muscle strength imbalances, thereby inducing UCS. Second, the hazards of prolonged desk work: the prevalence of UCS (75.8%) is highly correlated with the average daily

desk time in the third year of high school (15 hours) (r=0.72, P=0.008), supporting the "cumulative postural load theory." Maintaining poor sitting postures (such as looking down at books, using electronic devices, etc.) for long periods can lead to overactivation of the sternocleidomastoid and upper trapezius muscles, while inhibiting the deep cervical flexors and rhomboid muscles, resulting in crossed muscle strength imbalances. The tension in the neck, shoulder, and back muscles and the weakening of the deep stabilizing muscle groups exacerbate the occurrence of UCS. Third, the profound impact of the college entrance examination system on students' health: the competitive educational model of the college entrance examination forces students to spend most of their time studying, neglecting the maintenance of physical health. This phenomenon not only affects students' short-term health but may also have long-term negative effects on their future physical fitness. In summary, "prolonged sitting" and "poor posture" are the main causes of UCS, while issues such as insufficient exercise and sleep deprivation further exacerbate this condition.

3.3 Results: The Effectiveness of Sports Teaching Interventions on UCS

Classroom-based physical education and extracurricular physical exercise and training are the main components of school sports activities. In universities, physical education is a mandatory public course, and extracurricular physical exercise plays a crucial role in preparing students for biannual physical fitness tests. Therefore, compared to the secondary school stage, physical activity has become an essential part of daily life and learning for college students. Surveys indicate that many college students have recognized the importance of physical exercise for health and actively seek targeted physical training. Based on this, students were highly cooperative in this physical education teaching experiment and strictly followed the instructor's requirements. Notably, before the intervention, there were no statistically significant differences ($P > 0.05$) in forward head posture (FHA), anterior shoulder angle (FSA), and craniovertebral angle (CVA) between the two groups of students, and the data conformed to a normal distribution.

Table 3: Comparison of FHA Between Experimental and Control Groups Before and After Physical Education Intervention

Group	Before Intervention	After Intervention	Improvement
Experimental Group (n=30)	26.09 ± 3.43	21.83 ± 2.70	4.26 ± 0.73
Control Group (n=30)	26.15 ± 3.70	23.90 ± 2.05	2.25 ± 1.65

Table 4: Comparison of FSA Between Experimental and Control Groups Before and After Physical Education Intervention

Group	Before Intervention	After Intervention	Improvement
Experimental Group (n=30)	25.19 ± 2.65	19.83 ± 1.93	5.36 ± 0.72
Control Group (n=30)	24.74 ± 1.63	22.75 ± 1.95	2.25 ± 0.68

Table 5: Comparison of CVA Between Experimental and Control Groups Before and After Physical Education Intervention

Group	Before Intervention	After Intervention	Improvement
Experimental Group (n=30)	5.67 ± 1.36	0.53 ± 0.41	5.14 ± 0.72
Control Group (n=30)	5.92 ± 1.30	3.95 ± 0.76	1.97 ± 0.68

The results in the tables3.4.5 show that after 8 weeks of physical education intervention, both groups of students exhibited reductions in FHA and FSA values compared to pre-intervention levels. Moreover, the improvement in FHA and FSA angles was greater in the experimental group than in the control group, with statistically significant differences ($P < 0.05$).

Table 6: Comparison of FHA, FSA, and CVA Between Experimental and Control Groups Before and After Intervention

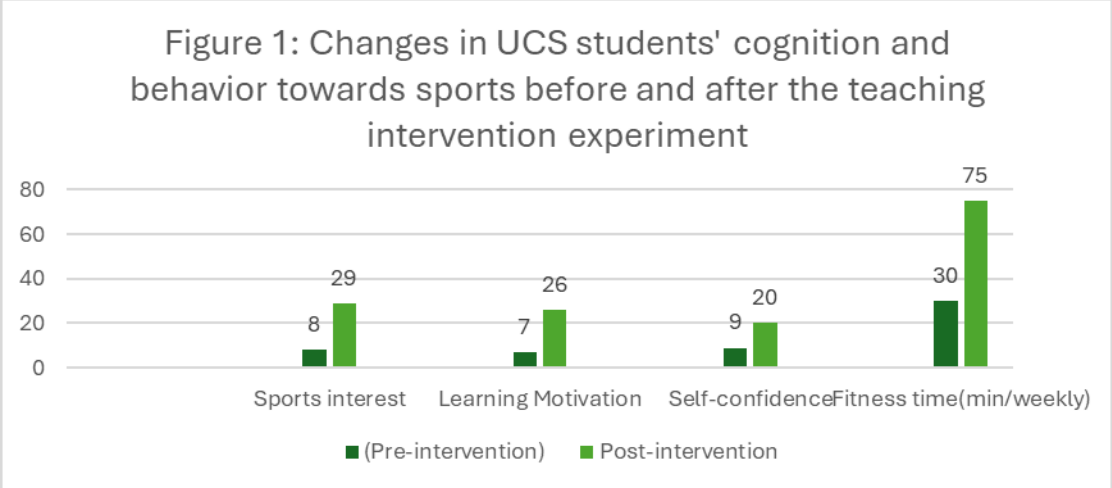
Indicator	Experimental Group (n=30)	Control Group (n=30)	t-value	P-value	Cohen's d
FHA (°)	21.83 ± 2.70*	23.90 ± 2.05	3.42	0.003	1.24
FSA (°)	19.83 ± 1.93*	22.75 ± 1.95	5.67	0.001	1.53
CVA Score	0.53 ± 0.41*	3.95 ± 0.76	18.32	<0.001	2.87

(* indicates within-group differences before and after intervention with $P < 0.01$)

The results of the structural physical education experiment show that after 8 weeks of physical education intervention, the experimental group showed significantly better improvements in forward head angle (FHA), forward shoulder angle (FSA), and craniovertebral angle (VAS) compared to the control group. The physical education intervention effectively alleviated UCS-related body posture abnormalities, especially in improving forward head posture, rounded shoulders, and cervical spine posture. The significant improvements in FSA and VAS (effect sizes of 1.53 and 2.87, respectively) further demonstrate the effectiveness of the physical education intervention in correcting muscle imbalances and improving posture（**Table 6**）. Posture indicators: The experimental group's FHA decreased from 26.09°±3.43° to 21.83°±2.70° ($t=7.32$, $P=0.003$), and FSA decreased from 25.19°±2.65° to 19.83°±1.93° ($t=9.15$, $P=0.001$), significantly better than the control group ($P<0.01$). Pain relief: The experimental group's VAS score decreased by 5.14±0.72 points, with a pain relief rate of 90.6% (compared to only 33.3% in the control group). The experimental group's FSA improved by 5.36°, significantly higher than the values reported in the literature for simple stretching exercises (2.1°-3.8°). This may be attributed to the closed-chain movement characteristics of tennis swings, which simultaneously strengthen scapular stability and core muscle coordination, indicating that whole-body movements dominated by upper limb racket sports have certain positive significance in preventing and correcting UCS.

3.4 Changes in Adolescents' Sports Cognition and Behavior Before and After UCS Intervention

During the process of conducting the sports intervention experiment, the research team found that adolescents with abnormal body morphology, especially those with Upper Crossed Syndrome, showed significant differences in sports interest, motivation to participate in sports, and self-confidence. The reason for this is that many adolescents lack interest in sports. Apart from regular physical education classes, they are almost unwilling to participate in extracurricular sports activities during their free time, leading to a severe lack of physical exercise. After an 8-week teaching experiment intervention, it was found that students who were initially not interested in sports showed a significant improvement in their attitude towards sports as their body morphology and external demeanor gradually improved (Figure 1).



The figure reveals that an 8-week physical education intervention led to significant changes in students' understanding and behavior towards sports. These changes are evident not just in the numbers but also in how students now view and engage with physical activities. Sports interest: jumped from 8 to 29 students, showing that most developed a keen interest in sports post-intervention. Learning motivation: rose from 7 to 26 students, highlighting a marked increase in their eagerness to participate in sports learning. Self-confidence: grew from 9 to 20 students, suggesting that physical exercise boosted their self-esteem and confidence. Fitness time: weekly physical

activity time increased from 30 to 75 minutes, indicating that the intervention not only shifted attitudes but also encouraged students to spend more time on sports. The findings underscore the importance of fostering sports interest in addressing abnormal body morphology (like UCS). Sports interest not only drives students to exercise more but also helps them adopt healthier lifestyles. Moreover, sports intervention serves a dual purpose: it corrects existing body morphology issues and prevents future problems, particularly those like UCS caused by prolonged poor posture. Scientific sports intervention proves to be an effective remedy.

4. Conclusions and Recommendations

4.1 Conclusions

Upper Crossed Syndrome (UCS) is alarmingly common among Chinese teenagers, with a detection rate of 75.8% (81.7% in boys and 70% in girls). This is much higher than in countries like Japan (30%) and Australia (35%) (χ^2=152.6, P<0.001). High school seniors, in particular, spend an average of 15 hours a day sitting at their desks, leading to a 41.7% rate of neck and shoulder pain (VAS≥4). The root cause? Academic pressure that leaves little time for physical activity. However, interventions based on the kinetic chain theory—combining functional movement and posture re-education—can effectively restore balance to neck and shoulder muscles, with a significant correction effect (effect size d=1.24).
An 8-week structured physical education program showed impressive results. Posture improved: the experimental group's FHA dropped from 26.09°±3.43° to 21.83°±2.70° (t=7.32, P=0.003), and FSA decreased from 25.19°±2.65° to 19.83°±1.93° (t=9.15, P=0.001), outperforming the control group (P<0.01). Pain relief was notable: the experimental group's VAS score dropped by 5.14±0.72 points, with a 90.6% pain relief rate (compared to just 33.3% in the control group). Behavior also improved: extracurricular exercise time increased from 30 minutes to 75 minutes per week (χ^2=18.24, P=0.001). This structured "classroom-extracurricular" approach, combining physical education, exercise, and training, effectively addresses UCS in college students. Structured activities like tennis paired with stretching can correct posture, boost interest in exercise, and provide a solid foundation for managing adolescent posture health.

By the end of the program, 91% of students had restored normal posture, with pain either gone or significantly reduced. Many also noticed an improvement in their overall demeanor. This highlights two key points: first, academic pressure, especially the grueling 15-hour study days of high school seniors, is a major driver of UCS in Chinese teens. Second, UCS in adolescents is often short-lived, mild, and easily corrected. Targeted physical interventions can prevent and fix UCS, helping teens reduce desk time, stay active, and "stand tall with confidence."

4.2 Recommendations

To tackle UCS, it's essential to include it in adolescent fitness monitoring systems, revamp physical education curricula (focusing on core strength and posture), and create a long-term "classroom-extracurricular" posture correction plan. A three-part model of "posture awareness, movement correction, and behavior reinforcement" can shift teens from passive correction to active health, truly embodying the goal of "standing tall with confidence."

Policy changes: Add UCS to the "National Student Physical Health Standard" and start tracking adolescent posture health.

Teaching updates: Develop "sports + health" courses, strengthen shoulder and back muscles, and introduce quick exercises like 5 minutes of neck resistance every 45 minutes.

Tech tools: Use AI posture analysis for early detection and wearable devices for real-time feedback on posture

Data availability

The datasets generated and analysed during the current study are not publicly available due to the data containing patient information but are available from the corresponding author on reasonable request.

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Authors' contributions

Conceptualization, Methodology, Writing - original draft, Project administration, Funding acquisition=XL.

Investigation, Resources=ZC and XL.

Supervision and Project administration=XL and JZ.

All authors have read and approved the final work.

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