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Original Article

Effects of Yumeiho Therapy and Gamified Corrective Exercise on Forward Head Angle and Hyperkyphosis in Male Adolescents

Abouzar Saadatian[1], Mahmood Farzami[2], Asma Negahdari[3], Hans Degens[4,5]

[1]Department of Sport Sciences, Faculty of Humanities, Yasouj University, Yasuj, Iran;
[2]Department of Sport Sciences, Islamic Azad University, Khorasgan Branch, Isfahan, Iran;
[3]Department of Occupational Engineering Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran;
[4]Manchester Metropolitan University, Life Sciences, Manchester, UK;
[5]Institute of Sport Science and Innovation, Lithuanian Sport University, Kaunas, Lithuania

Abstract

Objectives: Forward head angle (FHA) and thoracic hyperkyphosis are common in adolescents. We compared Yumeiho therapy, gamified corrective exercises, and their combination on FHA and kyphosis in male adolescents with these postural deviations. **Methods**: Sixty students (FHA: 55.9 ± 5.0°; kyphosis: 46.3 ± 3.2°) were allocated to Yumeiho, corrective exercise games, combined treatment, or control (n = 15 each). Interventions lasted 8 weeks (3 sessions/week, 45–60 min). FHA and thoracic kyphosis were assessed before and after the intervention. Repeated-measures ANOVA was used as the primary inferential model to examine group, time, and group × time effects for kyphosis and FHA. Percentage change was calculated as a secondary analysis to compare the magnitude of improvement between groups, followed by one-way ANOVA and Bonferroni post hoc tests. **Results**: Significant effects were found for time and group, with significant group × time interactions for both kyphosis and FHA (all $p \leq 0.003$). Baseline values did not differ between groups. Percentage-change analysis showed that the combined intervention produced the greatest improvement in kyphosis. For FHA, the combined intervention improved outcomes more than Yumeiho therapy, whereas superiority over the exercise group was not demonstrated. **Conclusion**: Yumeiho therapy and gamified corrective exercise both improved forward head angle and thoracic kyphosis. The combined intervention produced the greatest improvement in thoracic kyphosis and better forward head angle improvement than Yumeiho therapy, but superiority over exercise alone for forward head angle was not established.

Keywords: Adolescent, Corrective Exercises, Forward Head, Kyphosis, Yumeiho Therapy

Introduction

Forward head angle and hyperkyphosis is defined by the head being positioned forward and thoracic hyperkyphosis[1]. The natural curvature of the spine, i.e., thoracic kyphosis, is between 20° and 40°, whereas an angle greater than 45° is considered hyperkyphotic. Spinal deformities have been reported in 23–30% of children of school age, with poor posture observed in up to 58%[2], and are the result of prolonged sitting and screen time and heavy backpacks[3]. Forward head and hyperkyphosis results from musculoskeletal imbalances, which may include relatively weak deep cervical flexors and rhomboids and relatively strong upper trapezius and pectorals[4],and approximately 60% of affected individuals are impacted posturally[5]. If left untreated, forward head and hyperkyphosis can result in chronic neck and shoulder pain, restricted movement, and long-term musculoskeletal dysfunction[6] and has a negative impact on quality of life and academic performance among adolescents[7]. Timely

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Corresponding author: AbouzarSaadatian, Department of Sport Sciences, Faculty of Humanities, Yasouj University, Yasuj, Iran
E-mail: a.saadatian@yu.ac.ir
ORCID: 0000-0003-3232-9727

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and effective action is therefore important to improve the quality of life, academic, and physical performance of adolescents and prevent any progression of forward head and hyperkyphosis.

Various interventions, such as manual therapy, corrective exercises, and multimodal methods, have been suggested for the treatment of forward head and hyperkyphosis[8]. Yumeiho therapy, which is a type of Japanese manual therapy, is performed by soft tissue compression as well as joint manipulations and spinal manipulations to restore musculoskeletal homeostasis, and there is some evidence of the benefits of this treatment for spinal deformities and spinal pain[9]. There is also some evidence that posture improvement corrective exercises aimed at strengthening posturally weak muscles and stretching posturally tight muscles benefit the forward head and hyperkyphosis[10]. Better results may be obtained by combining manual therapy with gamified exercise.

Gamified exercise is astructured physical activity program that integrates game-design elements - such as points, challenges, feedback, rewards, levels, and competition - into exercise tasks with the goal of enhancing motivation, engagement, adherence, and performance. These exercises rely on behavioral science principles (e.g., intrinsic motivation, feedback loops, self-determination theory) to make physical training more interactive and enjoyable[11]. Indeed, gamified exercise has been shown to help correct alignment and to release soft-tissue restrictions (addressing underlying imbalances), and thereby reinforce the corrective motor patterns. This synergy – structural realignment and highly motivated retraining – provides a coherent rationale for combining manual Yumeiho therapy with gamified corrective exercise in musculoskeletal rehabilitation. In support of combined treatment, studies in adults have shown that manual therapy plus stabilization exercises yields superior posture and pain outcomes compared to exercise alone[12]. Despite these promising interventions, clinical evidence in adolescents remains scarce. To our knowledge, only a few trials have tested postural interventions specifically in young people (e.g. corrective exercise programs in teenage athlete[13], and none have compared Yumeiho versus gamified exercise or their combination in adolescent forward head and hyperkyphosis. This gap is notable given that many musculoskeletal issues have origins in youth and that adolescence is a critical period for growth and habit formation. Compared with traditionally less engaging exercises, corrective exercises with a challenge format increase compliance and motivation[14,15], and there is potential that a combination of manual therapy and gamified corrective exercises could be even more effective than either intervention alone in improving the structure and function of the forward head and hyperkyphosis[16]. To our knowledge, only three studies have focused on these techniques in adolescents, demonstrating a lack of comparative studies of their efficacy in adolescents with forward head and hyperkyphosis.

The aim of this study was therefore to compare the effects of Yumeiho therapy, corrective exercise games, and their combination on Forward head angle and thoracic kyphosis in male adolescents with forward head and hyperkyphosis. We hypothesized that all interventions improve Forward head angle and kyphosis compared with the control group, with the combined intervention yielding the greatest improvements.

Materials and Methods

Study Design

This was a four-arm pretest-posttest controlled intervention study with matched-block randomization. The four groups were Yumeiho therapy, corrective exercise games, combined intervention, and control. To minimize potential confounding and ensure baseline equivalence across the four study arms, a matched block allocation procedure was employed. Participants were stratified based on baseline spinal deformity angle and grouped into homogeneous blocks of four.

Within each quadruplet, participants were randomly allocated to one of the four groups using a computer-generated random sequence to achieve a 1:1:1:1 ratio: 1) Yumeiho therapy group, 2) corrective exercise games group, 3) combined intervention group (Yumeiho + corrective exercises games), and 4) control group.

Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes (SNOSE) until the interventions were assigned. All baseline assessments (pretests) were conducted prior to this allocation. The research took place in Kazeron, Iran, from January to March 2024.

Participants

Sixty 13- to 17-year-old male students with confirmed forward head and hyperkyphosis were enrolled in the study from Kazeron secondary schools in Iran. The diagnosis of forward head angle and hyperkyphosis included a forward head angle >45° and thoracic kyphosis >42°[17,18]. Participants were excluded if they had spinal or upper extremity surgery within the past 6 months, neck or lumbar injuries within the past 3 months, any neurological or systemic disorders, missed more than 2 intervention sessions or had participated in other corrective programs.

Adherence and Fidelity

All interventions were delivered over an 8-week period by certified professionals in a school gymnasium under direct supervision. Participants attended only the scheduled intervention sessions. Intervention delivery followed predefined protocols for each group to promote consistency across sessions. All participants completed the 8-week intervention, no adverse events were reported, and all 60 participants were included in the final analysis.

Blinding

Outcome assessments were performed by an assessor who was blinded to group allocation. Due to the nature of the interventions, participant and therapist blinding was not feasible.

Monitoring of Potential Confounding Factors

Participants were asked to report major changes in physical activity participation, additional therapeutic interventions, or other factors that could influence study outcomes during the intervention period. This monitoring was conducted for observational purposes only, and detailed quantitative records were not collected. Therefore, formal between-group comparisons for these variables were not performed.

Sample size calculation

An a priori power analysis was performed using G-Power 3.1.9.7. The test family was F tests, and the selected statistical test was ANOVA: repeated measures, within-between interaction. The analysis used an alpha level of 0.05, power of 0.80, four groups with equal allocation, and Cohen's f = 0.5. Based on these inputs, the minimum required sample size was 40 participants[19]. To account for possible attrition, 60 participants were recruited. Given the presence of four groups and the possibility of participant dropout, a total of 60 participants were selected. The selected large effect size was based on prior intervention studies on corrective exercises in adolescents, providing adequate power to identify meaningful differences between groups[20,21].

Measurements

All measurements were conducted by an examiner with 5 years of experience. pre-test measurements were conducted 1 week before the intervention, and post-test measurements were taken within 48 hours after the final session.

- Forward head angle was evaluated via photographic analysis. The subjects were standing in a relaxed posture, and side photographs were taken with a Canon EOS 1D digital camera held 2.65 m away. The forward head angle, which is the angle between the vertical line through C7 and the line from C7 to the tragus of the ear, was calculated via AutoCAD software. The landmarks were marked at the tragus and C7 spinous process. The measurement was very reliable (ICC=0.92)[3,17,22].
- Thoracic kyphosis was measured via a flexible ruler conforming to the thoracic spine (T1–T12) while the participants stood naturally. The curve on the paper was measured, and the kyphosis angle was calculated via the formula $\theta = 4 \times \arctan(2H/L)$, where H represents the curve height and L represents the curve length. This method was found to be reliable to a high extent (ICC=0.89)[23].

Interventions

Interventions were delivered over 8 weeks (3 sessions/week, 45–60 min per session) by certified professionals (a Yumeiho therapist with 10 years of experience and a corrective exercise specialist with 7 years of experience). All the sessions were conducted at a school gymnasium. Participants were instructed to perform only the supervised sessions and were not asked to perform exercises outside the study sessions.

- **Yumeiho Therapy Group**: Participants received standardized Yumeiho therapy targeting the spine and upper quarter of the thorax. Techniques included soft tissue compression, cervical retraction manipulation, and spinal alignment manoeuvres (5–10 s hold per technique). The protocol followed established guidelines[9]. Workload progressed biweekly by increasing glide depth and traction force: Weeks 1–2 (8–12 cycles, 5-s hold, 30% "pressure pain threshold" measured with a hand-held pressure algometer (or equivalent device) at the exact cervical or thoracic segment to be treated).Three measurements were taken, each separated by at least 30 s, and the mean of those three readings was recorded as that individual's 100% reference force. The exercise was as follows at weeks 3–4 (12–15 cycles, 7 s hold, 50% pressure), 5–6 (15–20 cycles, 8 s hold, 70% pressure), and 7–8 (20–25 cycles, 10 s hold, 85% pressure). Each session included 10min of light pressing warm-up and 10 min of neck stretches for cool-down (Table 1).
- **Corrective Exercise Games Group**: Participants performed gamified exercises designed to strengthen postural muscles and improve thoracic extension. Exercises included "Superman" (thoracic extension), "ball toss" (scapular stabilization), cervical retraction movements, and team-based challenges using resistance bands and light weights (0.5–1 kg)[15]. The workload was advanced on the basis of the number of sessions and increasing levels of resistance: weeks 1-2 (2 sets, 8-10 reps, low resistance), weeks 3-4 (3 sets, 10-12 reps, moderate resistance), weeks 5-6 (3 sets, 12-14 reps, moderate resistance), and weeks 7-8 (4 sets, 15 reps, high resistance). Each session consisted of a 5–10 minute dynamic warm-up (e.g., arm circles) and 10 minutes of static stretching (e.g., chest openers) (Table 2).
- **Combined Intervention Group**: Participants in the combined intervention group received both Yumeiho therapy and gamified corrective exercises within the same session. Approximately half of the intervention time was allocated to Yumeiho therapy and the remaining half to corrective exercise activities. They followed the same sequence of interventions as the individual groups. The session structure was as follows: 5 minutes of warm-up, 50–55 minutes of intervention, and 5 minutes of cool-down.
- **Control Group**: All participants were instructed to maintain their usual daily activities and not to initiate new exercise programs, rehabilitation treatments, or lifestyle

Table 1. Yumeiho Therapy Protocol.

Week	Techniques	Workload Progression	Session Details	Focus Area
1–2	1. Spinal compression (T1–T12) 2. Cervical Retraction Manipulation (gentle posterior glide) 3. Shoulder girdle pressing 4. Upper thoracic stretching 5. Scapular mobilization	Light intensity: 8–12 reps per technique, 30% max pressure	45 min: 10 min warm-up (light pressing), 25 min main techniques (5 min per technique), 10 min cool-down	Initial relaxation and FHP alignment
3–4	1. Thoracic spine manipulation 2. Cervical Retraction Manipulation (with mild traction) 3. Scapular stretching 4. Deep cervical pressing 5. Pectoral release	Moderate intensity: 12–15 reps, 50% max pressure	50 min: 10 min warm-up, 30 min main techniques (6 min per technique), 10 min cool-down	Thoracic mobility and FHP correction
5–6	1. Deep tissue compression (upper back) 2. Cervical Retraction Manipulation (deep glide) 3. Pelvic alignment 4. Thoracic rotation adjustment 5. Suboccipital release	Moderate-high intensity: 15–20 reps, 70% max pressure	55 min: 10 min warm-up, 35 min main techniques (7 min per technique), 10 min cool-down	Kyphosis and FHP improvement
7–8	1. Full spine mobilization 2. Cervical Retraction Manipulation (sustained traction) 3. Scapular winging correction 4. Upper back myofascial release 5. Cervical side-bending correction	High intensity: 20–25 reps, 85% max pressure	60 min: 10 min warm-up, 40 min main techniques (8 min per technique), 10 min cool-down	Postural stabilization and FHP

Notes: ***Cervical Retraction Manipulation****: This technique involves a controlled posterior glide of the cervical spine to counteract FHP. The therapist places hands on the participant's chin and occiput, gently guiding the head backwards while maintaining a neutral neck position. Progression includes increased depth (glide distance) and traction force over several weeks, adapted from Yumeiho's manipulative approach.* ***Workload Progression:*** *Intensity (% of maximum pressure) and repetitions increase biweekly. For the cervical technique, "reps" refer to cycles of retraction and release (e.g., 8–12 cycles in Weeks 1–2), with hold times progressing from 5 seconds (Weeks 1–2) to 10 seconds (Weeks 7–8).* ***Warm-up/cool-down****: Light pressing and neck stretches (e.g., lateral flexion) prepare and relax the cervical region, reducing strain during FHP-focused manipulation.*

Table2. Corrective Exercise Game Protocol.

Week	Exercise/Game	Workload Progression	Session Details	Focus Area
1–2	1. Superman Fly (prone thoracic extension) 2. Ball Toss (scapular retraction with band) 3. Head Balance (cervical retraction with book) 4. Wall Angel (thoracic alignment) 5. Posture Mirror (standing alignment game)	2 sets, 8–10 reps, 10-sec hold, low resistance	45 min: 10 min warm-up (dynamic stretches), 25 min games (5 min per game), 10 min cool-down	Muscle activation and awareness
3–4	1. Superman Relay (team thoracic extension) 2. Band Pull Challenge (scapular strengthening) 3. Neck Tug-of-War (cervical retraction with band) 4. Chest Opener Race (pectoral stretch with band) 5. Scapula Squeeze Tag (retraction hold)	3 sets, 10–12 reps, 15-sec hold, moderate resistance	50 min: 10 min warm-up, 30 min games (6 min per game), 10 min cool-down	Strength and coordination
5–6	1. Superhero Pose-Off (thoracic extension with weights) 2. Scapula Tag (retraction with resistance) 3. Chin Tuck Race (cervical retraction) 4. Plank Posture Hold (core and thoracic alignment) 5. Band Row Battle (upper back strengthening)	3 sets, 12–15 reps, 20-sec hold, moderate-high resistance	55 min: 10 min warm-up, 35 min games (7 min per game), 10 min cool-down	Endurance and posture correction
7–8	1. Superman Circuit (thoracic extension + plank) 2. Band Battle (scapular retraction + rotation) 3. Posture King (full alignment challenge) 4. Cervical Retraction Relay (with resistance) 5. Thoracic Twist Game (rotation with band)	4 sets, 15 reps, 25-sec hold, high resistance	60 min: 10 min warm-up, 40 min games (8 min per game), 10 min cool-down	Postural stability and strength

Notes: Workload progression*: Sets, repetitions, hold times, and resistance (e.g., band tension or light weights) increase biweekly to increase strength and endurance progressively.* ***Warm-up/cool-down****: Dynamic stretches (e.g., arm circles, cat-cow) and static stretches (e.g., chest opener, neck stretch) to prepare and recover muscles.*

Table 3. Descriptive Statistics for Demographic Variables in each Group.

Variable	Exercise	Yumeiho	Combined	Control	p value
Age (years)	14.5±1.1	14.2±0.9	14.7±1.1	14.9±1.1	0.315
Body mass (kg)	67.9±10.5	62.7±4.5	63.5±4.7	60.1±10.3	0.072
Height (m)	1.67±0.04	1.64±0.06	1.68±0.03	1.65 ±0.08	0.132
BMI (kg/m^2)	24.2±3.4	24.4±1.9	22.6±1.9	22.2±4.1	0.120
***Note**: The values are presented as the means ± standard deviations. P values are from one-way ANOVA tests comparing the four groups.*					

Table 4. Repeated-measures ANOVA results for study variables.

Time × Group Effect	Group Effect	Time Effect	8 Week	Baseline	Kyphosis
Exercise	40.6 ± 5.0	46.3 ± 2.8	F=113.67 P=0.001* η^2:0.67	F=5.08 P=0.003* η^2:0.21	F=23.22 P=0.001* η^2:0.55
Yumeiho	42.5 ± 2.5	46.4 ± 2.6			
Combination	37.1 ± 3.2	46.6 ± 3.8			
Control	46.3 ± 3.5	45.8 ± 3.2			
Forward head					
Exercise	46.0 ± 4.0	57.2 ± 4.7	F=181.51 P=0.001* η^2:0.76	F=7.31 P=0.001* η^2:0.28	F=25.97 P=0.001* η^2:0.58
Yumeiho	47.8 ± 3.7	56.2 ± 4.6			
Combination	41.8 ± 2.4	55.2 ± 4.4			
Control	55.8 ± 6.4	55.2 ± 6.2			
***Note:** *: significant difference, η^2: Partial eta squared (effect size), Baseline: Pre-intervention values, 8 Week: Post-intervention values after 8 weeks.*					

changes during the study period. Outside physical activity, screen time, and any additional treatments were monitored using weekly self-report logs.

- **Data collection**: All the measurements were performed under identical conditions (temperature 22–24°C, absence of interfering factors). The participants wore only shorts. The data for both the pre-tests and post-tests were collected in the same environment to minimize bias.

Statistical Analysis

All the statistical analyses were conducted via SPSS v 24. The normality of the data was checked via the Kolmogorov-Smirnov test, and the homogeneity of variance was assessed via Levene's test. The significance level for all the statistical tests was set at 0.05. Repeated-measures ANOVA was used as the primary analysis to evaluate the effects of time, group, and the group × time interaction on kyphosis and forward head angle. When a significant interaction was observed, percentage change from baseline to post-intervention was calculated and analyzed as a secondary comparison using one-way ANOVA with Bonferroni correction. The formula for calculating the percentage change from baseline to post intervention was as follows:

$$\% \text{ Change} = ((\text{posttest} - \text{pretest})/\text{pretest}) \times 100$$

Descriptive statistics (means, standard deviations, and 95% confidence intervals) were computed for each variable within each group. One-way analysis of variance (ANOVA) with eta square was used to evaluate group differences in the percent change in the kyphosis and forward head angles. Where significant effects were found, pairwise comparisons were performed via Bonferroni correction. To explore clinical relevance, we used a distribution-based MCID reference for forward head posture, following Heydari et al. (2022), who reported MCID values of 1.40° for forward head angle and 1.34° for shoulder angle in students with forward head posture[24]. No validated MCID was applied for thoracic kyphosis.

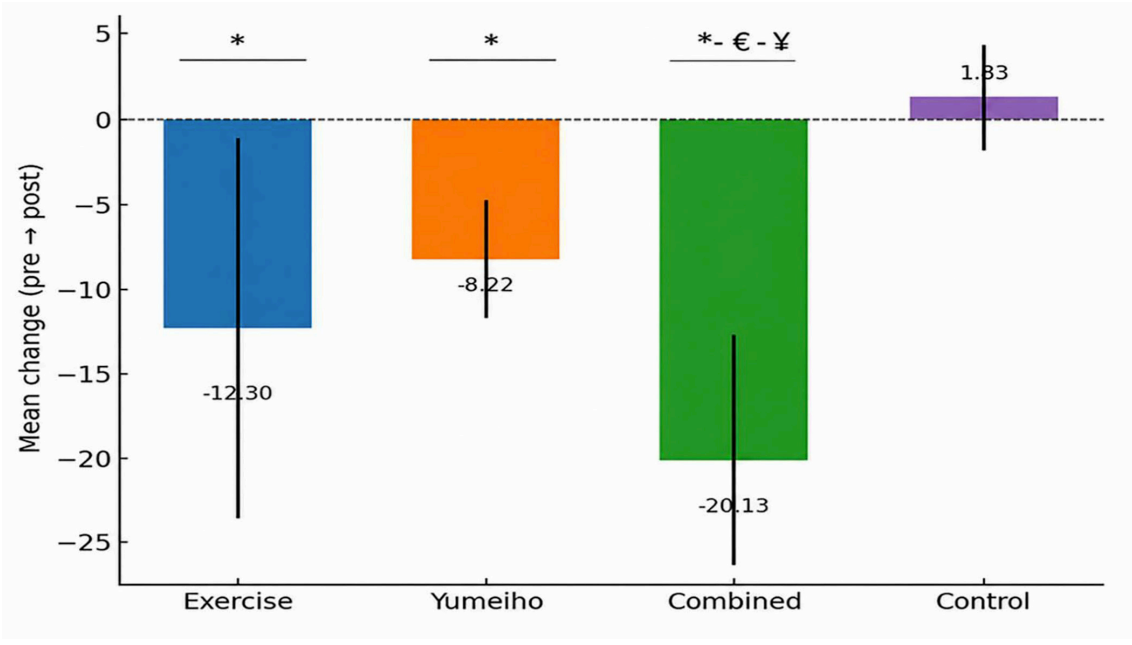

Figure 1. Percentage change (mean ± SD) in the kyphosis angle after gamified exercise, Yumeiho therapy or combined intervention. Percentage change (mean ± SD) in kyphosis angle after gamified corrective exercise, Yumeiho therapy, or combined intervention. Negative values indicate a reduction in kyphosis angle, reflecting improved thoracic posture. *Indicates a significant difference from the control group; € indicates a significant difference from the exercise group; ¥ indicates a significant difference from the Yumeiho group (P < 0.05).

Results

All 60 participants completed the study, and no adverse events were reported. At baseline age, body mass, height and BMI did not differ significantly between the four groups (p>0.05) (Table 3).

As shown in Table 4, the repeated-measure ANOVA revealed significant effects of group and time, and significant group × time interactions for both kyphosis and forward head angle. At baseline, there were no significant differences in forward head angle and kyphosis between the groups. Paired-samples t-test showed no significant pre–post changes in the control group for either kyphosis angle ($t_{(14)}$= -1.597, p= 0.133) or forward head angle($t_{(14)}$= -1.547, p= 0.144).

The significant interactions indicate that the changes in kyphosis and forward head angle differed between groups. One-way ANOVA revealed significant group differences in the percentage change in the kyphosis angle ($F_{(3,56)}$ = 23.47, p < 0.001, η^2= 0.557; Figure 1). According to conventional benchmarks, the effect size is “large”. Post hoc Bonferroni comparisons indicated that both exercise (p < 0.001, 95%CI: -20.77 to -6.50) and Yumeiho (p= 0.003, 95%CI: -16.68 to -2.41) had better results than the control, but there was no significant difference between the benefits of exercise and Yumeiho (p= 0.737). The combined intervention produced better results than the control (p < 0.001, 95%CI: -28.60 to -14.33), exercise (p= 0.024, 95%CI: -14.96 to -.69) and Yumeiho (p < 0.001, 95%CI: -19.04 to -4.78) regimens did for hyperkyphosis.

One-way ANOVA revealed significant group differences in the percentage change in the forward head angle ($F_{(3,56)}$= 34.46, p < 0.001, η^2= 0.649; Figure 2). According to conventional benchmarks, the effect size is “large”. Posthoc Bonferroni comparisons showed that exercise (p<0.001,95%CI: -27.12 to -12.93), Yumeiho (p=0.003, 95%CI: -22.74 to -8.56) and the combined intervention regimen (p<0.001, 95%CI: -31.93 to -17.74)had better results than the control. The combined intervention resulted in larger improvement compared to Yumeiho (p= 0.005, 95%CI: -16.27 to -2.08). However, no significant difference was found between the combined intervention and exercise groups for forward head angle.

Discussion

This study showed that Yumeiho therapy, corrective exercise games, and their combination all reduced Forward head angle and kyphosis, supporting the efficacy of both manual therapy and gamified exercises in addressing

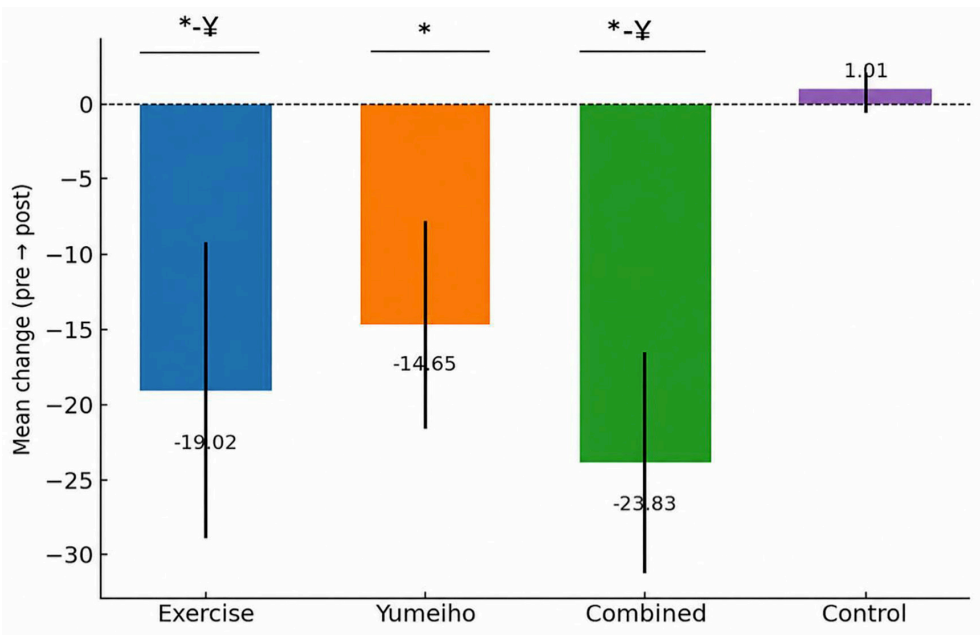

Figure 2. Percentage change (mean ± SD) in forward head angle after gamified exercise, Yumeiho therapy or combined intervention. Percentage change in forward head angle (%) (Data are presented as mean ± standard deviation. * Indicates a significant difference from the Control group; € indicates a significant difference from the Exercise group; ¥ indicates a significant difference from the Yumeiho group ($P < 0.05$). Negative value indicates a reduction in forward head angle, reflecting improved head and neck positioning.

postural deformities. Compared with exercise or Yumeiho therapy alone, the combined intervention yielded superior improvements in the kyphosis angle. These results echo prior recommendations that the most effective posture-correction programs target multiple factors (e.g., strength, flexibility) over several weeks by exercise[25].

Some studies have shown that manual methods do not provide any significant advantage beyond the additional practice itself[18,19]. Possible explanations may include differences in the participants and the measurement procedures.

Exercise and manual therapy correct posture via complementary mechanisms. Muscle strengthening exercises that maximise activation of muscles of the anterior neck and back, and stretching posterior neck and anterior chest muscles, have been shown to decrease forward head angle and kyphosis by improving muscular balance, whereas massage deep tissue compression (upper back) reduces soft-tissue stiffness, and thoracic spine manipulation improves mobility in the thoracic spine and shoulders. Similar to our observations, Jung et al. (2020) demonstrated that both mechanical massage and manual therapy significantly reduce thoracic kyphosis and increase spinal extension ROM, highlighting that massage interventions have a beneficial impact on spinal alignment[26].

However, passive techniques do not increase strength; therefore, we expected that the exercise-alone group may have achieved larger (and perhaps more durable) postural gains by actively reinforcing weak muscles. While Kamali et al. (2016) reported that exercise and manual therapy (including massage, mobilization, and muscle energy techniques) were effective in reducing the hyperkyphosis angle and head posture[27], a combined intervention likely benefited from both effects: it relaxed tight tissues while simultaneously strengthening postural stabilizers. In line with this suggested synergism, Bayattork et al. (2020) reported that the best improvements occurred when programs included both stretching and strengthening components over at least six weeks[22]. Similarly, Fathollahnejad et al. (2019) reported that adding manual therapy to scapular stabilization exercises produced significantly greater improvements in forward head and shoulder posture than exercise alone[25], and Mylonas et al. (2021) reported that combining targeted soft-tissue mobilization with neuromuscular exercises led to a much greater improvement in the craniovertebral angle than Yumeiho plus the same exercises. In those three studies, the multicomponent intervention outperformed single-modality programs[28], in line with our observation

of additional benefits of adding Yumeiho to the exercise intervention.

Although the Yumeiho group improved (consistent with evidence of the benefit of manual therapy for alignment), the improvement was less than in the exercise group. One explanation is that Yumeiho effects may be more transient and less specific than postural muscle training. Exercise regimens directly address the underlying muscular imbalances of forward head posture (e.g., weak cervical flexors and scapular retractors) and thoracic rounding, producing measurable angle changes. The minimal change in the control group indicates that the results were not due to mere time.

Clinical Application

The combined intervention appeared to provide the greatest benefit for thoracic kyphosis. For forward head angle, the combined program improved outcomes more than Yumeiho therapy, but no clear superiority over corrective exercise alone was demonstrated. Therefore, the findings support the potential value of combining interventions, while there was no evidence for added benefit over exercise alone for forward head angle.

Limitations

There are several limitations to acknowledge. Firstly, the study did not measure potential mediators of postural improvement—such as muscle strength, proprioception, or neuromuscular activation—restricting the ability to confirm the mechanisms underlying the observed changes. Secondly, the applicability of the results to males or other age groups, or to populations with different cultures and lifestyles may be restricted by the use of male adolescents. Thirdly, the relatively brief 8-week intervention and the absence of long-term follow-up put an upper bound on conclusions about the maintenance of the observed improvement. The fourth limitation is the absence of an attention-control or sham intervention in the control group. Therefore, some of the observed effects may reflect the impact of non-specific factors such as therapist attention, participant expectations, or Hawthorne effects. Although outside physical activity and co-interventions were monitored via self-report, the possibility of residual confounding cannot be fully excluded. The fifth limitation is that because the combined intervention group received longer sessions and greater therapist contact time than the single-modality groups, the superior outcomes observed in this arm may partly reflect treatment dose and attention effects, and not evidence of synergy alone. Finally, the absence of prior registration as a clinical trial may introduce a risk of bias, particularly with respect to transparency in prespecified outcomes and analytical strategies.

Conclusion

In summary, the student participants demonstrated improvements in posture across all treatment groups. Yumeiho therapy and gamified corrective exercise both improved forward head angle and thoracic kyphosis. The combined intervention produced the greatest improvement in kyphosis and showed better forward head angle improvement than Yumeiho therapy, but there was no superiority over exercise alone for forward head angle. Future studies with biomechanical assessments (e.g., electromyography or muscle strength measures), larger samples, randomized control trials, extended follow-up periods, and more diverse populations are needed to determine the wider applicability and to what extent these interventions elicit long-term clinical benefits.

Ethics Approval

The study protocol was approved by the Research Ethics Committee of Islamic Azad University, Khorasgan Branch (IR.IAU.KHUISF.REC.1402.326). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent to Participate

Written informed consent was obtained from all participants and their parents/legal guardians prior to participation in the study.

Authors' Contributions

AS, MF, AN: Design of the study. AN and MF contributed to data acquisition and intervention implementation. AS, AN: Interpretation of data. AS, HD: Drafted the work or significantly revised it, critically revised the manuscript for important intellectual content. AS, HD, AN, MF: Approved the submitted version, along with any substantially modified iterations that reflect the author's contributions to the study.

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