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Article

Research on the promotion effect of personalized training program based on biomechanics on the physical health of college students

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Abstract: Biomechanics-based personalized training programs can significantly improve physical health among college students, but there is limited evidence on how these programs affect spinal twist stretch function and overall health, despite previous research demonstrating the potential benefits of such programs. In this study, the influence of a biomechanics-based personalized training program investigates the physical health of a college student population. This study involved 68 college students, divided into two groups: 34 participants undergoing a personalized biomechanics-based training program (Group A) and 34 participants following a standard exercise regimen (Group B). The training program included exercises designed to enhance spinal twist stretch activation and stability. The participants' core muscle activation was recorded through EMG from rhomboids, latissimus dorsi, and external obliques, while kinematic data were obtained from a three-dimensional motion analysis system. The assessments were done pre and post-8-week structured nutrition and physical activity modification period. These data are stimulated using SPSS, to compare pre and post-test measurements within each group and to determine the differences between spinal twist stretch and global physical health gains using paired t-tests, analyze of variance (ANOVA) descriptive statistics, and correlation analysis. The result demonstrated that Group A significantly improved spinal twists, stretch, and physical health among college students. Exercises targeting specific biomechanical principles exhibited more pronounced spinal twist stretch activation. The program improved trunk stability and movement accuracy, with a moderate correlation between muscle activation and overall physical health improvements. This approach improved core stability and muscle function but also led to better overall health outcomes compared to standard exercise regimens.

Keywords: personalized training program; biomechanics; statistical analysis; muscle activation; physical health; college students

1. Introduction

Physical health refers to the overall well-being of the body, and the efficiency of organs such as the respiratory system, muscular system, and cardio-vascular system, among other systems in the body [1]. It refers to maintaining one's health through the consumption of a proper diet, regular exercise, adequate rest, and periodic health checkups. A dynamic state of bodily self-organization that enables people to accomplish their objectives and proceed about their everyday lives painlessly [2].

Sustaining physical well-being necessitates an extensive plan that incorporates several lifestyle components. Frequent exercise increases flexibility, cardiovascular fitness, and muscle strength [3]. A balanced diet offers the necessary nutrients for both development and repair. Recovery and general functioning depend on getting enough sleep, and preventative measures like immunizations and regular physicals can identify any problems before they become serious ones [4]. Through cultivating behaviors that support physical health, people can reduce their chance of developing chronic illnesses, lengthen their life expectancy, and feel better about themselves overall. Any movement of the body caused by skeletal muscle is considered physical activity [5]. Exercise is a type of physical activity delivery that is characterized as a planned activity focused on enhancing physical well-being and quality of life in addition to preserving essential physiological systems, such as the metabolism and muscular skeletal systems [6]. In addition to aerobic exercise training that improves cardiopulmonary function when done at the right intensity, resistance training is thought to be one of the most effective approaches to build skeletal muscle.

Prescription exercise is affordable and can boost a patient's physical activity by 10% if they are comparatively sedentary [7]. The World Health Organization (WHO) recommends and defines it as an exercise prescription that physicians prescribe to help their patients exercise, considering the individual health, degree of physical fitness, and cardiovascular health of the patient, in addition to the findings of the physical examination (which includes tests and exercise) [8]. The prescription indicates the nature of the exercise, how it should be done, the intensity, duration, and frequency of the activity, along with the precautions that should be observed while doing the exercise. As offering a unique approach to every participant's fitness needs enhances the adherence and effectiveness rates of programs, personal training has become popular [9]. These programs can focus on enhancing specific aspects of an athlete's performance and can also address such issues as overtraining or the occurrence of an injury by designing workouts that are compatible with the physique of a given athlete [10]. Innovative procedures like structural assessments are often utilized in this customizing phase to assist in designing workout routines that are aligned with an individual's movement pattern and patterns of muscle recruitment. Apart from solving the problems of enhancement of specific kinds of performance, focused exercise can also be effective for one's physical activity and health [11].

Muscle exercises are essential for improving physical functioning and fitness, especially when included in a customized training program. These workouts target certain muscle areas, enhancing flexibility, endurance, and strength. An individual can strengthen their muscles more effectively and in a balanced manner by using personalized exams and concentrating on muscle activation [12]. For proper movement of any motion involving the extremities, proximal stability is crucial. The worldwide as well as national spinal musculatures are major supporters of this stability. Global muscles, which comprise bigger muscle groups such as rectus abdominis and erector spinae, create movement and provide overall stability [13]. The capacity to appropriately modify exercises to meet each person's needs without constant professional supervision and the availability of resources or equipment could represent barriers to a customized training program. The aim of the research is to examine the impact of biomechanics-informed individualized exercise regimens on college students' spinal twist stretching ability along with their overall quality of life. The analysis was performed between a personalized training program and a regular one in the context of the level of physical health, muscle activity, and core stability showed more significant results in comparison with the standard program.

Contribution

- This study used a regular exercise program and a tailored training program based on biomechanics, with evaluations conducted before and after 8 weeks using 3D motion analysis and EMG.
- Two groups of sixty-eight college students were formed: thirty-four (Group A) participated in a customized biomechanics-based program, while thirty-four (Group B) maintained a regular exercise schedule.
- Paired t-tests, ANOVA, descriptive statistics, and correlation analysis were conducted using SPSS, indicating a greater degree of effectiveness from the customized program in improving trunk stability and general health.
- Through individualized training, Group A outperformed Group B in terms of spinal twist stretch, activation of core muscles, and general physical well-being.

To ensure that the research is presented clearly and comprehensively, the remaining portion of the study is divided into many sections. Section 2 provides the appropriate work by reviewing earlier research and foundational studies that set the current study in context. Section 3 covers several methodologies and provides an explanation of the research techniques and tactics applied. An analysis of the outcomes and their ramifications, including the experimental data, is given in Section 4. A discussion is given in Section 5. Section 6 successfully wraps up the research by providing a summary of the major results, explaining the relevance of the findings, and suggesting possible subjects for further study.

2. Related works

The efficacy of conventional physical education programs and the systematic approach to using fitness technologies in higher education were contrasted in the study [14]. Two experimental groups (EG) and two control groups (CG) comprised 232 students, ages 18 to 20 that took part in the study. The findings demonstrated that, in comparison to CG students, the EG students' health indices were dramatically improved by the authors' methodical strategy. It demonstrated the value of contemporary fitness devices in the context of physical education.

The impacts of a game-designed physical education curriculum on pupils in grades ten through twelve's mental and physical health were examined in research [15]. The outcome indicated that both groups enhanced their level of physical fitness, however their cardiorespiratory fitness did not in the test. They suggested that for improving cardiorespiratory fitness, games could prove equally as beneficial as more conventional training techniques but that physical education alone does not appear to be enough to cause change in that area.

Chinese college students' subjective well-being (SWB) and physical activity (PA) were shown to be positively correlated in the study [16]. Moreover, the paper discovered that higher life satisfaction as well as happiness were associated with fulfilling moderate-to-vigorous PA (MVPA) criteria. However, once subjective health status was accounted for, these relationships were reduced in magnitude. Furthermore, they proposed that educational facilities need to organize exercise routines and encourage increased levels of MVPA to enhance students' psycho-emotional well-being.

The use of sports biomechanics in the prevention and treatment of sports injuries was examined [17]. It draws attention to how essential the discipline was for maximizing athletic performance, avoiding injuries, and easing recovery. Important concepts like kinematics and kinetics were covered, in addition to biomechanical evaluation methods like electromyography and motion capture devices. Prospects for the future include multidisciplinary cooperation, artificial intelligence, and machine learning.

The lumbar-pelvic region's activation and stability during core stabilization training were examined [18] and emphasized on 3D motion kinematic data and EMG data. In the study, a reformer with varying tension settings was used to perform "side splits" on 28 healthy women. In contrast to lighter springs, which promoted more symmetrical motion of the hips, the study indicated that substantial springs stimulated more muscles. They found that core stability exercises were useful for developing pelvic and trunk stabilization because they stimulate deep abdomen and back muscles when performed on unstable surfaces.

To ascertain the impact of Pilate's expertise on co-contraction and core muscle activation, research [19] evaluated 32 participants 16 experienced Pilate practitioners and 16 inexperienced practitioners. The experienced Pilate instructors were able to better stimulate the core muscles of the abdomen and low back, which improved pelvic and trunk stability. In the mobility section, they also discovered a modest association between greater and more precise motions and activation of muscles in the core. The results implied that Pilates could serve as a useful kind of exercise for treating musculoskeletal conditions.

The leg press, Smith machines (SM), and squats with core muscular surface electromyography (sEMG) at 3-repetition maximum (3RM), research [20] investigated turnover amplitude. 3RM exercises were done by 19 ladies who had been resistance training for 4.5 years. Comparing leg press workouts to free weights and the SM, the amplitude of the sEMG in the core muscles was lower. Compared to squats and free weights, leg press workouts exhibited higher 3RM loads. They suggested including core muscles in the kinetic chain by performing squats.

Exercises for core stability were reported to enhance reduced Gmax and TrA muscle thickening and lessen patients' impairment in comparison to individuals who were denied such treatment [21]. Exercise and control groups included 32 participants in the research. Transcutaneous stimulation of the nerves and a "hot pack" were administered to the control group. The workout group finished sixteen core stability exercises. While there was a significant group impact for contracted thickness, there were significant time effects for relaxing muscle thickness, EMG signals, discomfort, and disability. All dependent variables showed a non-significant interaction impact, according to the data.

Ten healthy individuals participated in a study [22], which discovered that aging can have an impact on the stability of the stand-to-sit (StandTS) movement, especially in older persons. They compared to younger individuals, older persons showed shorter RF EMG burst durations, decreased trunk flexion, and decreased stability. It implied that StandTS instability in aging was linked to reduced trunk flexion and poor rectus femoris (RF) muscular eccentric control. They contended that to address the problems, StandTS training must be a component of a thorough balance intervention.

The effect of abdominal hypopressive training (AHT) on females aged 18 to 60 years old's ability to manage their posture and the function of their trunk muscles [23]. The control group (CG) received no treatment for eight weeks, whereas the experimental group (EG) attended two 30-minute sessions every week. Postural control was evaluated through stabilometric platform, and ultrasonic imaging in real time was used to activate the transverse abdominal muscle (TrA). After eight weeks of AHT, observed significant improvement in deep trunk muscular contraction and postural regulation.

Sixty healthy adults, ages twenty to thirty-six, were included in the study [24] to examine respiratory muscle strength, trunk muscular endurance, and lung function. A positive correlation was noted among the results of Sorensen tests, flexor endurance, and forced vital capacity. Also, favorable correlations were observed between maximum inspiratory pressure (MIP) with the prone bridge as well as Side Bridge tests. The trunk muscular endurance supports core stability and it can improve respiratory function by connecting respiratory muscle strength with pulmonary function.

A very dependable test for assessing muscular strength using abdominal trunk muscle (ATM) training equipment was observed in research [25]. Twelve fit males and eight fit females participated together with seven other fit males who were undergoing a fitness regimen. The apparatus exhibited higher stiffness after training sessions and higher uptake of 18F-fluorodeoxyglucose in some muscles. Also, the effectiveness of the gadget in enhancing ATM strength was confirmed, which means that strengthening using the device can help in the functioning of the diaphragm, pelvic floor, as well as abdominal muscles.

To develop potential workers with flawless physical and healthcare abilities, a study [26] outlined a systematic approach for integrating contemporary fitness technology into student physical education. It focused on its intention, goals, guiding ideas, methods, formats, and resources. The method helps in the development of values-based perspectives toward fitness technology, exercise, and healthy living.

It was discovered that a 15-week university health/wellness course improved 125 undergraduate students' levels of moderate-to-vigorous physical activity (MVPA) [27], psychosocial variables, and health-related fitness knowledge (HRFK). MVPA increased in correlation with increased exercise self-efficacy. According to the study, taking one of the courses could be able to lessen the usual drops in MVPA that occur in college students.

The influence of sustained physical activity on female college students' physical fitness was examined in the study [28]. For 10 weeks, 240 students were split up into resistance, aerobic, and control groups. Comparing resistance training to aerobic exercise, the results demonstrated a considerable improvement in task performance and control. The study emphasized how crucial it was for female university students to include exercise in their physical wellness.

The impact of a physical education curriculum based on virtual realities on students' physical health in Korean primary schools was investigated in research

[29]. Ninety individuals were divided into two groups for the study, the experimental group met three times a week for eight weeks, whereas the control group did not take part. Power, strength of muscles, endurance for breathing, and general health-related physical fitness were shown to differ significantly between the control and experimental groups.

The influence of static stretching and functional corrective training on college students' movements and physical fitness was examined in the study [30]. In the research, thirty male college students from Guangzhou, China participated. They were randomized to two groups: the FCT (functional corrective training) group and the static stretching group. For six weeks, both groups participated in a training intervention where FCT concentrated on static stretching exercises and flexibility training. The FCT group significantly improved their hurdle step, inline lunge, rotational stability, and composite scores.

3. Methodology

In this study, 68 college students participated in a specific training program based on biomechanics to assess their spinal twist stretch and overall physical health. Two groups of participants were formed, Group A and Group B. Using SPSS to assess muscle activation and kinematic data pre- and post-8 weeks, it was shown that, in comparison to the normal training routine, the tailored program significantly improved trunk stability, spinal twist stretch, and general health.

3.1. Samples

Initially, 480 college students were surveyed for the study. Of these, 300 students were not selected, and 112 students did not attend. A total of 68 students were selected using online questionnaires and were split into two groups, 34 for Group A and 34 for Group B. The study examined the demographic features of the participants in both groups. Group A average age was 20.5 ± 1.2, whereas Group B's average age was 20.7 ± 1.3. Together, the two group's average age was 20.6 ± 1.2. The distribution of genders was 16 males and 18 females in Group A and 15 males and 19 females in Group B, for a total of 31 males and 37 females. The average BMI for each group was likewise similar, reaching22.4 ± 2.5 for Group A, 22.6 ± 2.7 for Group B, and 22.5 ± 2.6 generally. In comparison to Group A (22 intermediate, 12 advanced), Group B (21 intermediate, 13 advanced) had greater fitness levels. Group A had an average of 2.5 years prior exercise experience, while Group B had an average of 2.4 years. Six members of Group B and four of the ten members of Group A had prior injuries. **Table 1** and **Figure 1** shows the **(a)** Distribution of participants' age **(b)** BMIof participants **(c)** previous exercise experience.

Table 1. Demographic data.

Demographic characteristics	**Group A (*N* = 34)**	**Group B (*N* = 34)**	**Total (*N* = 68)**
Age	20.5 ± 1.2	20.7 ± 1.3	20.6 ± 1.2
Gender	16 males, 18 females	15 males, 19 females	31 males, 37 females
Body mass index (BMI)	22.4 ± 2.5	22.6 ± 2.7	22.5 ± 2.6
Fitness level (Self-reported)	22 intermediate, 12 advanced	21 intermediate, 13 advanced	43 intermediate, 25 advanced
Previous exercise experience (years)	2.5 ± 1.1	2.4 ± 1.2	2.4 ± 1.2
Health issues (injuries)	4 with prior injuries	6 with prior injuries	10 with prior injuries

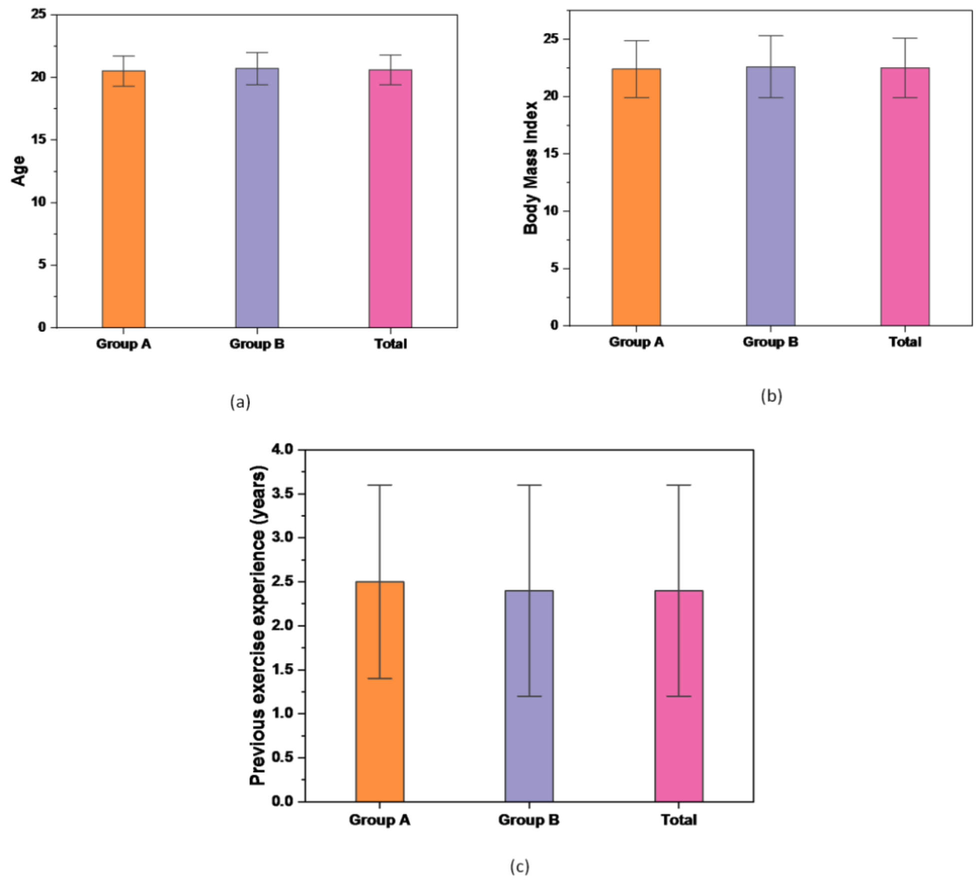

Figure 1. Sample data. **(a)** Age; **(b)** BMI; **(c)** previous exercise experience.

3.2. Assessment methods

Participants had a thorough evaluation both before and after the 8-week test to determine the efficacy of the biomechanics-based individualized training program. Surface electromyography (EMG) was used to quantify spinal twist stretch, with particular attention focused on activation levels in the rhomboids, latissimus dorsi, and external obliques during certain exercises. A 3D motion analysis system was also used to gain more precise kinematic data and assess trunk consistency, motion exactitude, total biomechanical efficiency, and other factors during a variety of actions. Routine physical fitness tests that assess general physical fitness include strength, flexibility, balance, and aerobic fitness tests that give detailed information about a participant's bodily changes. It ensures that the influence of the program on specific muscular activity and general well-being is duly considered.

3.3. Muscle involvement in the spinal twist stretch

External obliques, latissimus dorsi, and rhomboids are necessary components for widening the spine. The latissimus dorsi is essential when it comes to moving and stabilizing the trunk and spine, while at the same time, rhomboids contribute towards shoulder blade contraction as well as stabilization. Hence, external tilt has to allow shoulder rotation plus lateral flexion for successful stretching. As depicted in the illustration, these muscles play a crucial role in enhancing core stability along with enhancing spinal mobility during physical activity.

Rhomboids

The muscles that connect the shoulders and spine are called rhomboids, and they are found in the upper back. These abilities are composed of rhomboid major and rhomboid minor muscles. Its primary purpose is to keep shoulder blades connected to ribs that assist in balance or facilitate movement of shoulder blades either outwards or inwards. Lifting heavy items as well as rowing cannot be executed without involving these muscles. Contributes to the aligning upper body while preventing curved shoulders. Henceforth, weak or tight quadriceps may lead to poor postures together with deformities at the shoulder region. **Figure 2** shows the spinal twist stretch muscles.

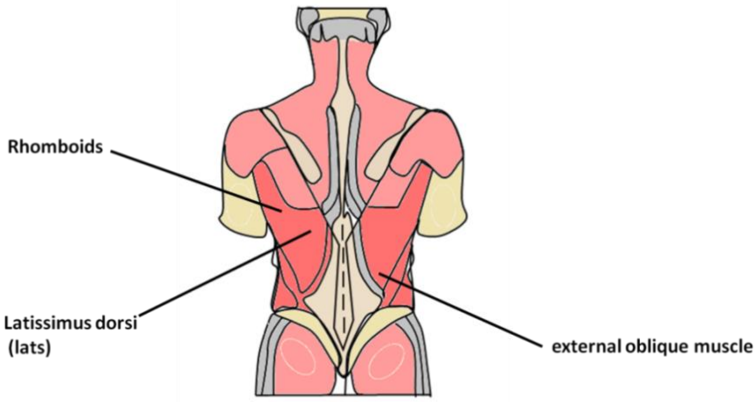

Figure 2. Spinal twist stretches muscles.

Latissimus Dorsi

The latissimus dorsi muscle, which is extensive in the lumbar region, spans from the lower spine to the middle part of the spine, the iliac crest, and one of the lower ribs up to the upper arm. It plays an important role in a variety of movements such as internal rotation, adduction, and shoulder extension that are significant for pulling or lifting tasks. Besides these functions, this muscle is important for maintaining good posture and proper function in that, it supports stability in both the pelvis and spine when moving. Swimming, rowing, and pull-ups are some of the activities in which this muscle group is greatly involved.

External Obliques

There are two smooth muscles that extend on both sides of the abdomen and remain from the lower ribs to the pelvis. These two muscles are called external obliques in movements such as twisting and bending. Their main role is to rotate the shoulders, release the sides, and compress the abdomen. In addition to maintaining posture and stabilizing the core, these muscles also support the diaphragm and assist with breathing. Increasing external obliques will strengthen core muscles, which improve stability during physical activities.

3.4. Data analysis

SPSS version 29.0 was used to analyze comprehensively during our investigation examining how a personalized biomechanics-based training program affects physical health among college students. It primarily focused on evaluating the efficacy of spinal stretches directed at the rhomboids, latissimus dorsi, and external oblique muscles. The analysis comprised descriptive statistics, which summarized the data, and ANOVA for comparing means between groups. Correlation analysis served to explore relationships between variables while paired t-tests assessed changes before and after the test. These approaches enable to rigorously assess the program's influence on muscle health and the general physical well-being of its participants.

4. Results

The efficacy of the training program was evaluated in this study by using paired t-tests to compare each group's pre- and post-test measurements. To show general patterns and variability, descriptive statistics provide an overview of the data, including means and standard deviation. The degree and direction of relationships between spinal twist stretch improvements and general physical health were assessed using correlation analysis. ANOVA was used to compare the impacts of the customized program compared to the regular regimen and ascertain whether the post-test results for the two groups differed in a statistically significant way.

4.1. Descriptive statistics

In this study, two groups pre- and post-test muscular strength for the rhomboids, latissimus dorsi, and external oblique were measured in **Table 2** and **Figure 3 (a)** Rhomboids **(b)** Latissimus Dorsi **(c)** External Oblique. With pre-test values ranging from 14.0 to 28.0 and post-test values from 19.0 to 33.0, Group A demonstrated a substantial rise for the rhomboids, ranging from a pre-test mean of 20.1 ± 4.2 to 25.8 ± 5.1 post-test. Group B showed a little rise, ranging from 19.9 ± 3.9 to 21.4 ± 4.4; the values being in the range of 15.0 to 26.0 before the test and between 16.0 and 28.0 after the test. This implies that in comparison to Group B, Group A's rhomboid strength improved more significantly. Group A demonstrated a considerable improvement in Latissimus Dorsi, ranging from 22.4 ± 5.0 to 28.2 ± 4.6; pre-test values ranged from 15.0 to 32.0, while post-test values ranged from 21.0 to 36.0. With pre-test values ranging from 16.0 to 30.0 and post-test values ranging from 17.0 to 31.0, Group B similarly demonstrated improvement, ranging from 21.7 ± 4.8 to 23.0 ± 4.9. Group A experienced a significant rise in the External Oblique muscle, ranging from 18.3 ± 3.8 to 23.5 ± 4.2. Pre-test values for this muscle ranged from 13.0 to 25.0, whereas post-test values increased from 17.0 to 30.0. Pre-test values are between 14.0 and 26.0 and post-test values are between 15.0 and 28.0. Group B had a less pronounced rise from 18.1 ± 4.0 to 20.3 ± 4.1. Comparing Group A and Group B, Group A showed more notable gains overall in all muscle areas.

Table 2. Descriptive statistics test.

Muscle	Group	Pre-test Mean ± SD	Post-test Mean ± SD	Min (Pre)	Max (Pre)	Min (Post)	Max (Post)
Rhomboids	Group A	20.1 ± 4.2	25.8 ± 5.1	14.0	28.0	19.0	33.0
	Group B	19.9 ± 3.9	21.4 ± 4.4	15.0	26.0	16.0	28.0
Latissimus Dorsi	Group A	22.4 ± 5.0	28.2 ± 4.6	15.0	32.0	21.0	36.0
	Group B	21.7 ± 4.8	23.0 ± 4.9	16.0	30.0	17.0	31.0
External Oblique	Group A	18.3 ± 3.8	23.5 ± 4.2	13.0	25.0	17.0	30.0
	Group B	18.1 ± 4.0	20.3 ± 4.1	14.0	26.0	15.0	28.0

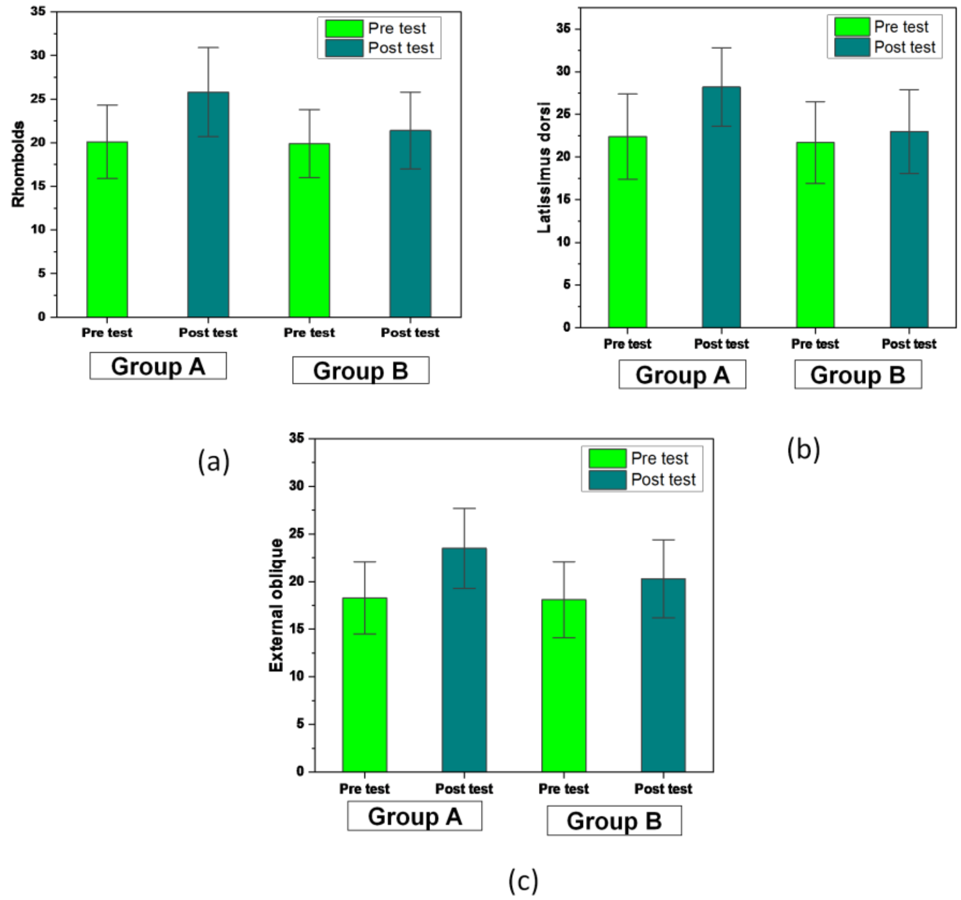

Figure 3. Descriptive statistics test. **(a)** Rhomboids; **(b)** Latissimus Dorsi; **(c)** External Oblique.

4.2. Paired *t*-test table

The statistics show distinct results for Groups A and B when comparing the pre- and post-test muscle strength improvements for the external oblique, latissimus dorsi, and rhomboids in **Table 3**. Group A showed a large improvement with a mean difference of 5.7 for Rhomboids, with $t-$value 6.84 and $p-$value < 0.001.

Group A's strength increased from 20.1 ± 4.2 to 25.8 ± 5.1 (significantly). As compared to Group A, Group B's mean difference was 1.5, which is statistically significant but less noticeable. Group B's growth was more moderate, coming in at 19.9 ± 3.9 and 21.4 ± 4.4, with a t-value of 2.12 and a $p-$value of 0.042. A notable and significant improvement was demonstrated by the 5.8 mean difference, $p-$value less than 0.001, and $t-$value of 7.25 that followed. Group B's Latissimus Dorsi strength increased from $21.7 \pm 4.8$to 23.0 ± 4.9, with a mean difference of 1.3, which is statistically significant but less significant than Group A. The $t-$value was 2.18, and the $p-$value was 0.036. Group A's external oblique muscle showed a substantial improvement with a mean difference of 5.2, a $t-$value of 7.68, and a $p-$value of less than 0.001.With $t-$value of 2.02 and $p-$value of 0.049, indicating a mean difference of 2.2, Group B similarly had a statistically significant improvement, increasing from 18.1 ± 4.0 to 20.3 ± 4.1.

Table 3. Paired *T*-test.

Muscle	Group	Pre-test Mean ± SD	Post-test Mean ± SD	*t*-value	*p*-value	Mean Difference
Rhomboids	Group A	20.1 ± 4.2	25.8 ± 5.1	6.84	< 0.001	5.7
	Group B	19.9 ± 3.9	21.4 ± 4.4	2.12	0.042	1.5
Latissimus Dorsi	Group A	22.4 ± 5.0	28.2 ± 4.6	7.25	< 0.001	5.8
	Group B	21.7 ± 4.8	23.0 ± 4.9	2.18	0.036	1.3
External Oblique	Group A	18.3 ± 3.8	23.5 ± 4.2	7.68	< 0.001	5.2
	Group B	18.1 ± 4.0	20.3 ± 4.1	2.02	0.049	2.2

4.3. ANOVA

Rhomboids, Latissimus Dorsi, and External Oblique ANOVA data are summed up by comparing within-group and between-group changes in **Table 4**. With respect to the Rhomboids muscle, the within-group variance ($SS = 376.20$) is substantially lower than the between-group variance (Sum of Squares, $SS = 58.40$), resulting in a Mean Square (MS) of 5.70 for the within-group variation and 58.40 for the between-group variation. The statistical significance of the difference between the groups is indicated by the F-value of 10.12, accompanied by a $p-$value of 0.002, indicating that there are discernible variations in the Rhomboids muscle between the groups under comparison. Similar results are shown in the Latissimus Dorsi muscle, which has an MS of 5.65 and 74.20, respectively, based on a within-group SS of 372.80 and a between-group SS of 74.20. The F-value of 13.15, with a p-value of 0.001, indicates a significant difference in muscle between the groups. With an MS of 67.50 and 5.49, the external oblique muscle exhibits a between-group SS of 67.50 and a within-group SS of 362.40. The $p-$value of 0.001 and the $F-$value of 12.30 both indicate significant group differences. All three muscles have p-values that are below the traditional alpha threshold of 0.05, indicating that the observed group differences are statistically significant.

Table 4. ANOVA test.

Muscle	Source of Variation	SS	df	MS	*p*-value	*F*-value
Rhomboids	Between Groups	58.40	1	58.40	0.002	10.12
	Within Groups	376.20	66	5.70		
Latissimus Dorsi	Between Groups	74.20	1	74.20	0.001	13.15
	Within Groups	372.80	66	5.65		
External Oblique	Between Groups	67.50	1	67.50	0.001	12.30
	Within Groups	362.40	66	5.49		

4.4. Correlation analysis

Table 5. Correlation analysis test.

Muscle	Group	*r*-value	*p*-value	Strength of Correlation
Rhomboids	Group A	0.45	0.006	Moderate
	Group B	0.30	0.042	Weak
Latissimus Dorsi	Group A	0.55	0.002	Moderate
	Group B	0.35	0.036	Moderate
External Oblique	Group A	0.60	0.001	Strong
	Group B	0.40	0.049	Moderate

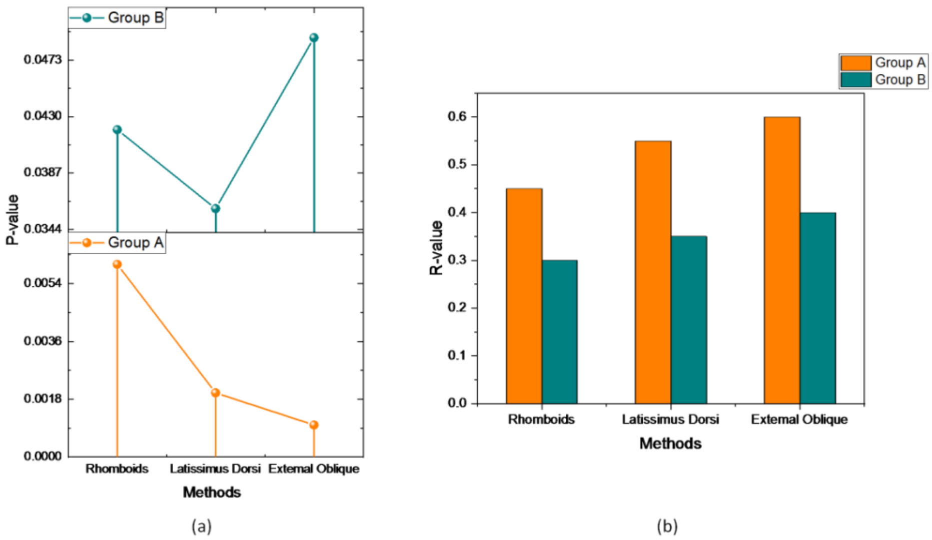

Figure 4. Correlation analysis test.**(a)** *p*-value; **(b)** *r*-value.

Different groups have differing degrees of link between the factors of interest and muscular strength, according to the correlation study in **Table 5** and **Figure 4a** *p*-value **(b)** *r*-value. With a statistically significant *p*-value of 0.006 and a moderately positive correlation ($r-$ value of 0.45), Group A shows an important connection with the Rhomboids. Compared to Group A, Group B exhibits a lesser correlation, with a statistically significant $r-$ value of 0.30 and *p*-value of 0.042, indicating a less prominent connection. In both groups, the Latissimus Dorsi muscle shows somewhat favorable relationships. Group A has a moderately strong and statistically significant connection, as indicated by the 0.55 correlation coefficient and *p*-value of 0.002. Group B has a moderate correlation that is comparable to that of Group A, with $p -$ value of 0.036 and $r -$ value of 0.35, indicating that the correlation is lower than in Group A.Group A demonstrates a robust and very significant connection for the external oblique muscle, with a significant $r -$ value of 0.60 and $p -$ value of 0.001. With a 0.40 r-value and 0.049 p-values, Group B's moderate positive correlation is statistically significant but less than that of Group A. In general, across the muscle groups examined, Group A shows more significant relationships than Group B.

5. Discussion

The rhomboids, latissimus dorsi, and external oblique muscles' mean ± standard deviation pre- and post-test muscular strength measures (Mean $\pm$ SD) for two groups, A and B, are compared in **Table 2**. After the test, all of the muscles in Group A had greater increases in muscular strength: the latissimus dorsi increased from 22.4 to 28.2, the external oblique increased from 18.3 to 23.5, and the rhomboids increased from 20.1 to 25.8. Group B's improvement was less pronounced, rising from 19.9 to 21.4 for the rhomboids, 21.7 to 23.1 for the latissimus dorsi, and 18.1 to 20.3 for the external oblique. The pre-and post-test value ranges also appear, illustrating the range of participant performance. The post- and pre-test results for the Rhomboids, Latissimus Dorsi, and External Oblique muscles in the two groups (Group A and Group B) are displayed in **Table 3**. In every muscle, Group A exhibits more gains than Group B, with significant changes ($p < 0.001$) and bigger mean differences. Group B improved by 1.5, whereas Group A improved by 5.7 (mean difference) for the Rhomboids. Group B increased by 1.3 and 2.2, respectively, but Group A gained more in the Latissimus Dorsi (5.8) and External Oblique (5.2). P-values all indicate statistically significant gains, with Group A exhibiting better outcomes. The findings of an analysis of variance (ANOVA) for muscular activity in three different muscles the rhomboids, the latissimus dorsi, and the external oblique are presented in **Table 4**. The muscle activity variance between two distinct groups is shown by the "Between Groups" row, while the variation between the same groups is represented by the "Within Groups" row. With $p -$ value of0.002 and $F -$ value of10.12 for the Rhomboids, the groups' differences are statistically significant. Comparably, the F-values for the External Oblique and the Latissimus Dorsi are 12.30 and 13.15, respectively, with a p-value of 0.001 and 0.001, indicating significant differences between the groups. The differences between the groups for all three muscles are statistically significant because all p-values are less than 0.05. The Rhomboids, Latissimus Dorsi, and External Oblique muscle groups are the three muscle groups for which **Table 5** presents the correlation between muscular strength and performance in Groups A and B. The Rhomboids in Group B exhibited a lower correlation ($r = 0.30, p = 0.042$) than the Rhomboids in Group A, which had a moderate correlation ($r = 0.45, p = 0.006$). Group A and Group B both had a moderate connection ($r = 0.55, p = 0.002$) for the Latissimus Dorsi, although a lesser one ($r = 0.35, p = 0.036$). Group A had a moderate correlation ($r = 0.40, p = 0.049$) while Group B exhibited a significant connection ($r = 0.60, p = 0.001$) with respect to the External Oblique. In conclusion, compared to

Group B, Group A usually showed greater relationships between muscular strength and performance across all muscles.

6. Conclusion

College students' physical health can be greatly enhanced by biomechanics-based personalized training programs, but little is known about how these programs impact spinal twists, stretch function, and general health. In this study, a tailored training program based on biomechanics affects the physical health of a group of college students. 68 college students participated in this study, split into two groups: 34 underwent Group A, while 34 adhered to Group B. Exercises aimed at improving spinal twist stretch activation and stability were included in the training regimen. Kinematic information was gathered using a three-dimensional motion analysis system, and EMG data from the participants' external obliques, latissimus dorsi, and rhomboids was used to record their muscle activation. Pre- and post-eight-week organized periods of physical activity and changes in diet were assessed. SPSS is used to collect this data, compare pre- and post-test measurements in each group, and use paired t-tests, descriptive statistics, correlation analysis, and ANOVA to ascertain the differences in spinal twist stretch and gains in overall physical health. The outcome showed that among college students; Group A considerably enhanced spinal twist, stretch, and physical wellness. Group A had higher strength improvements than Group B in the pre-and post-test muscular strength assessments for the latissimus dorsi, external oblique muscles, and rhomboids. Group B experienced less improvement than Group A, with latissimus dorsi increasing by 5.8, external oblique by 5.2, and rhomboids by 5.7. An analysis of variance revealed significant differences ($p < 0.05$) between the groups for every muscle, with Group A exhibiting higher associations between muscle strength and function.

Limitation and future scope

The sample size and brief length of this study, which may not adequately capture long-term effects or generalize across varied groups, restrict its ability to completely assess the promotion impact of a tailored training program based on biomechanics for the physical health of college students. In addition, discrimination may be introduced by the study's dependence on self-reported health measures. To confirm and extend the results, future studies should include larger sample sizes, longer follow-up times, and objective health assessments. Further investigation into distinct biomechanical characteristics and their respective effects on different fitness outcomes may improve the comprehension and efficacy of customized training regimens.

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