Participants

Thirty adolescents with DS aged 12-16 years, from Tajerouine's Public Handicap School (Kef, Tunisia) and their parents were asked to participate in the study. The inclusion criteria ensured that the selected participants fulfilled certain requirements, including (a) regular participation in physical education activities of at least once per week, (b) age between 12 and 16 years, (c) intelligence quotient (IQ) below 35, and (d) no prior experience in martial arts. The exclusion criteria encompassed: (a) the presence of significant physical disabilities that could potentially interfere with the exercise program (e.g., cardiac problems, epilepsy, injury, hearing impairment), and (b) the use of drug therapies related to a psychiatric diagnosis. Participants were randomly assigned to a control group (CG, n= 15) or a Tai-Chi training group (TG, n= 15). Of the 30 pre-selected participants, five adolescents from the CG abandoned the experimental protocol for personal reasons. Finally, 25 DS adolescents (age: 14.4±1.3 years; height, 1.5±0.09 m; body mass, 49.2±5.98 kg, body mass index (IMC): 21.7±1.51 kg/m^2) completed the program; 15 in TG and 10 in CG (Figure 1). The TG participated in 6 weeks of Tai-Chi training program although the CG maintained their normal daily activity. Participants and their parents were fully informed of the study's objectives prior to the start of the study. All parents or legal guardians gave written informed consent for their children to take part in the study. The Ethical Committee of the High Institute of Sport and Physical Education of Kef (February 24, 2022; UR22JS01/ISSEP-013-22) approved all procedures described in this study. The protocol was conducted in accordance with the declaration of Helsinki.

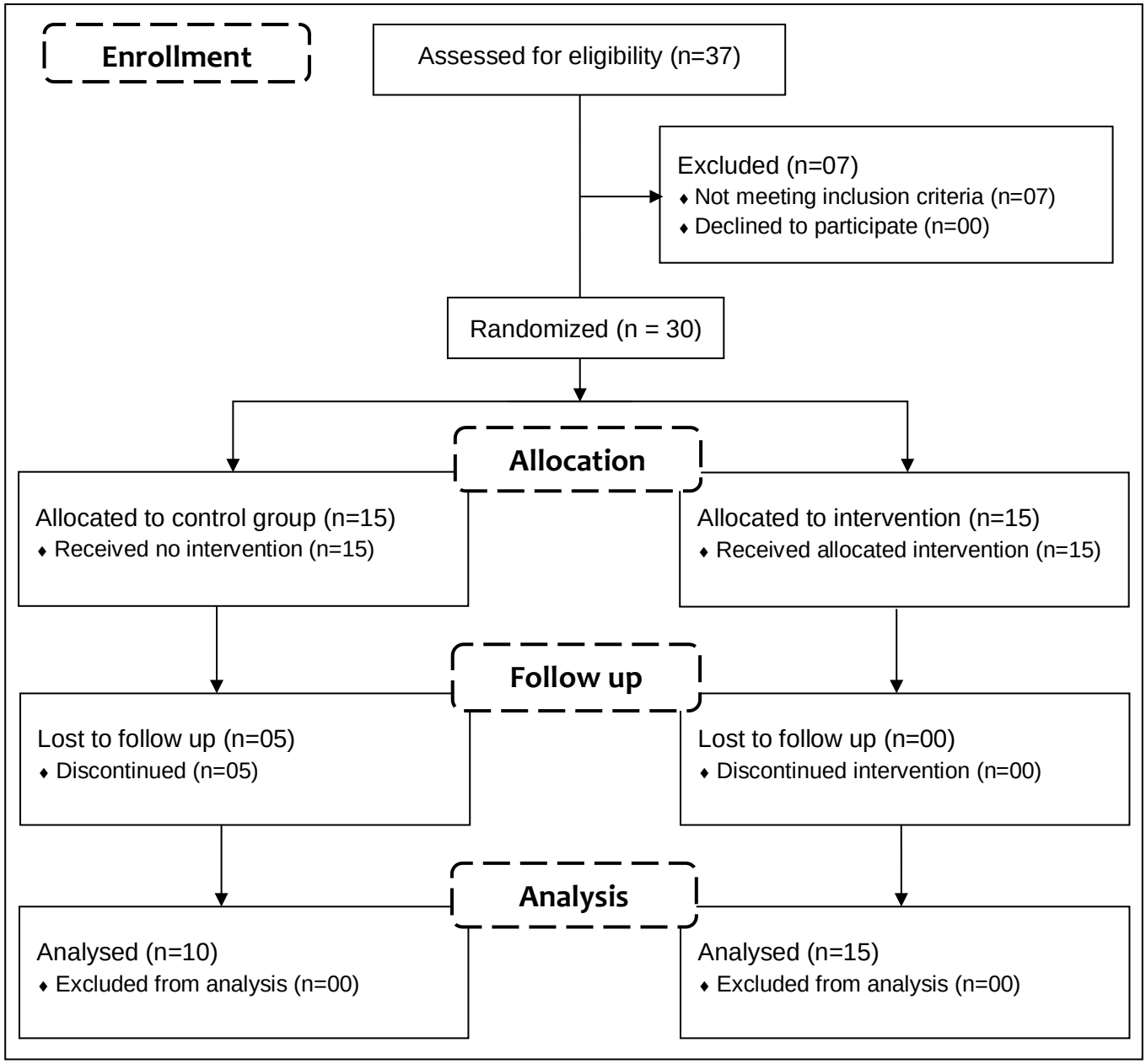

Figure 1. Consort flow diagram

Experimental Design

Our randomized controlled trial study was conducted with 25 DS participants between May and June 2022 (8 weeks). All outcome measures were assessed at baseline (week 1) and post-intervention (week 8) by the same investigator. At the beginning of the first week, the investigator asked parents to accurately complete the depression, anxiety, and stress scale. Then, all participants attended a familiarization session to become acquainted with the applied

experimental tests (i.e. physical fitness tests) and to assess anthropometric parameters (i.e. height and body mass). Participants underwent specific tests over three days: (1) anthropometric measurements and flexibility test were recorded; (2) medicine ball throw and standing jump, and (3) unipedal stance test were evaluated during the last day. All physical performance tests were preceded by a standardized warm-up consisting of 10-min of continuous jogging, 5-min of the stretching routine, and 2 minutes of rest. During testing sessions, strong verbal encouragement was provided by an investigator for participants to ensure maximal effort in each test. In addition, all students were instructed to follow their normal diet and to use the same sports clothes that they usually wear during physical education sessions. Tests were consistently conducted at the same time (between 9 a.m. and 11 a.m) and in the same indoors location where students learned physical education.

Tai-Chi training protocol

The intervention was designed in 6 weeks with three sessions per week on non-consecutive days (even days, from 11 am to 11.45 am). Each training session included a 10-minute warm-up, including range of motion and stretching, 25 minutes of practicing TC techniques including five forms: Single whip, Waving hands in clouds (WHIC), Bruch knee, Playing the lute and Repulse Monkey (RM) of Yang style TC are practiced during the program. Based on the participants' abilities, this protocol is led by a trainer and three assistants witch continuously encouraged the participants verbally with the aid of physical guidance, patterning and attention cues, section by- section practice. Participants were instructed to follow along and imitate the instructor's posture and motions throughout the training session and those who participated in the course and mimicked the actions of the coach, at the end of the training, they were given a prize and a success certificate. Finally, each session ends with a 10-minutes cool-down (stretching, breathing exercises).

Table 1. Tai Chi training program

Week	Therapeutic Tai chi exercise
1	Orientation, abdominal breathing
2	Single whip Bruch knee
3	Bruch knee Waving hands in clouds
4	Waving hands in clouds Playing the lute
5	Playing the lute Repulse Monkey

Anthropometric assessments

Body mass was measured to the nearest 0.1 kg, using an electronic scale (Omron BF508), with participants wearing light clothing and walking barefoot. A measuring tape fixed to the wall was used to determine height to the nearest 0.5 cm.

Standing broad jump

This test assesses lower limb explosive strength (LES) (in cm). The participant is given instructions to push off vigorously and jump as far as possible while standing behind the starting line. The contestant must land on their feet together and maintain their balance. The best score was kept after the test was performed twice. The distance is measured from the take-off line to the point where the back of the heel nearest to the take-off line lands on the mat. If the individual stumbled or touched the mat with another body part, a second try was permitted (Skowroński et al., 2009). Pilot data from 25 participants, collected during two familiarization sessions on two different test days, was used to determine the reproducibility of the test (ICC 0.998; 95%CI: 0.995-0.999).

Medicine ball push

Medicine ball throws were conducted in a seated position using a 1-kg medicine ball. Participants were asked to throw the ball as far and as fast as possible with both hands, starting from the center of their chest. Measurement was from the throwing line to the line at the nearest point of contact with the ground. The distance thrown was recorded to the nearest 5 cm. Three trials are recorded separated by 2 minutes of recovery between trials. The best score was taken for further analysis (Hackett et al., 2018). Pilot data from 25 participants, collected during two familiarization sessions on two different test days, was used to determine the reproducibility of the test (ICC 0.997; 95%CI: 0.994-0.999).

Flexibility Test

This test only assesses lower back flexibility and hamstring muscle extensibility (Bozic et al. 2010). This test requires you to sit on the floor with your legs straight ahead of you. Feet are placed flat against the box. The tester places both knees flat against the floor. The athlete slowly leans forward as far as possible toward a graduated ruler held on the box ranging from -25 to +25, holding the greatest stretch for 2 seconds. The distance before (negative) or beyond (positive) the toes is recorded as the score. The test is repeated twice, with the best score recorded each time. Pilot data from 25 participants, collected during two familiarization

sessions on two different test days, was used to determine the reproducibility of the test (ICC 0.909; 95%CI: 0.789-0.957).

Unipedal Stance Test

Participants stood on one leg for as long as they could with their arms along their sides and their eyes open. The investigator used a stopwatch to time how long the subject could stand on one limb. When the subject lifted his foot off the floor, time began. Time ended when the subject: (1) used his arms (ie, uncrossed arms), (2) moved the raised foot (toward or away from the standing limb or touched the floor), (3) moved the weight-bearing foot to maintain his balance (ie, rotated foot on the ground). The procedure was repeated three times, with each repetition being recorded on the data collection sheet. The longest time of the three trials was recorded. (Ito et al., 2023). Pilot data from 25 participants, collected during two familiarization sessions on two different test days, was used to determine the reproducibility of the test (ICC 0.992; 95%CI: 0.983-0.997).

Depression, anxiety, and stress scale

The purpose of the Depression Anxiety Stress Scale (DASS) is a self-report screening tool that uses the three subscales of depression, anxiety, and stress to assess the frequency of behaviors or the intensity of feelings. (Lai et al., 2015). The DASS-21 is a 21-item scale, four different answers ranging from 0 (doesn't apply to me at all) to 3 (applies to me a lot or most of the time) are available for each of the seven items scale. In the present study, we used the Arab version of the DASS-21 (Moussa et al., 2017) to measure the status of parents' psychological well-being before and after 6-week TC training of their children.

Statistical analyses

Data were expressed as means and standard deviations (SD). Normality of data was assessed and confirmed using the Kolmogorov-Smirnov test. Homogeneity of variance was tested using the Levene's test. The reliability of all tests was assessed by the intra-class correlation coefficient (ICC) and 95% confidence interval (95%CI). Anthropometric parameters, physical fitness tests and Dass-21 were assessed using a two-way analysis of variance (ANOVA) (2 groups x 2 times). If group-by-time interactions turned out to be significant, paired -Student tests were computed. Effect sizes (Cohen's d) were classified according to Hopkins et al. (2009) as trivial $\leq$0.2, small >0.2–0.6, moderate >0.6–1.2, large >1.2–2.0, and very large >2.0 magnitudes. Statistical analyses were performed with SPSS software version 22.0 (SPSS, Inc., Chicago, IL, USA). The level of statistical significance was set at $p \leq 0.05$.