Journal of Sports Physiology and Athletic Conditioning (J.S.P.A.C) 2025; 5 (17): 11-20

Research Article

Comparison of Tabata Training Effects on Physical Fitness and Body Composition in Female University Students with Normal Weight and Overweight: A Quali-Experimental Study

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Received: 6 August 2025
Accepted: 25 September 2025

Abstract

Introduction: Sedentary behavior among female university students is on the rise, often associated with weight gain and reduced physical fitness. Tabata training, a high-intensity interval training (HIIT) modality, was examined for its impact on body composition and fitness parameters in normal-weight and overweight female students.

Methods: In this study, 52 female students aged 20–25 were randomly divided into four groups: Tabata-normal weight (n=15), Tabata-overweight (n=11), control-normal weight (n=14), and control-overweight (n=12). A Tabata protocol was followed by the training groups for 8 weeks (3 sessions a week). The outcome measures included body weight, BMI, body fat percentage, VO2max, vertical jump height, and agility (4×9 m shuttle run). The data were analyzed using repeated-measure ANOVA and Bonferroni post-hoc tests.

Results: Body weight (P=0.014), BMI (P=0.017), fat percentage (P=0.009), and VO2max (P=0.021) all showed significant main effects, with group-by-time interactions also significant (P<0.05). Only the overweight Tabata group showed statistically significant improvements. Vertical jump (P=0.312) and agility (P=0.281) did not show any significant differences.

Conclusion: In overweight female students, an 8-week Tabata-based HIIT program significantly improved body composition and aerobic capacity, which supports its application in academic settings as an efficient and accessible fitness strategy.

Keywords:
HIIT; Tabata protocol; Female students; Body fat; Aerobic capacity

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1. Introduction

The benefits of regular physical activity include maintaining physical and mental health and reducing chronic disease risk. University students-especially females-are increasingly sedentary due to increased screen time, prolonged academic engagement, and limited access to structured exercise opportunities. There is an increased risk of weight gain, obesity, and metabolic disorders associated with lifestyle factors [1].
A lack of physical activity has been linked to adverse health consequences, including fat accumulation, reduced cardio-respiratory fitness, muscular atrophy, and psychological stress [2]. A key health marker is body composition, which refers to the distribution of fat, muscle, and bone mass. It has been shown that excess adiposity, especially in the abdominal region, compromises cardiovascular efficiency, reduces VO2max, and impairs postural and locomotor control [3]. The deterioration of strength, flexibility, endurance, and balance may also negatively impact academic performance and quality of life among students. It is widely recognized that high-intensity interval training (HIIT), particularly in the Tabata protocol, is a time-effective and effective method of exercising. Through short bursts of intense activity (20 seconds) interspersed with brief recovery periods (10 seconds), Tabata training improves both aerobic and anaerobic systems within a short period of time [5]. The use of HIIT and Tabata-based routines has been proven to decrease body weight, body mass index (BMI), and fat percentage, as well as boost VO2max, muscle strength, agility, and balance [6,7]. Following an eight-week Tabata intervention, Lu et al reported significant improvements in aerobic capacity and fat percentage among sedentary female students [8].
In a student population, Sooryajith et al found that Tabata training improved agility, balance, and flexibility after 12 weeks.
In general, HIIT is effective, but its benefits may differ depending on the body composition of the individual. It has been suggested that people with higher fat mass may experience more pronounced reductions in adiposity and significant improvements in aerobic capacity than those with normal weight [4]. As opposed to Murphy et al, Murphy et al report negligible changes in VO2max in sedentary subjects following HIIT.
Research on HIIT in populations stratified by weight status is limited, despite the growing body of literature on HIIT. This study investigated the effects of Tabata training on body composition and physical fitness in female university students with normal weight versus overweight students. A more targeted and effective strategy for enhancing health outcomes in this demographic may be to tailor interventions to their baseline physical profiles.

2. Methods

Participants

An 8-week Tabata intervention was evaluated using a quasi-experimental, pre-posttest design with four parallel groups, including two control groups.
Students from Islamic Azad University, Qazvin Branch (2023-2024 academic year) were recruited via campus posters and online announcements. A total of 73 individuals expressed initial interest, but only 60 met the inclusion criteria. We excluded 8 participants during the intervention period (2 due to musculoskeletal injury, 3 due to hormonal medication initiation, and 3 due to non-adherence [<80% attendance]).

Based on a random number table, 52 participants were randomly assigned to four groups: Tabata - Normal Weight (n = 15), Control - Normal Weight (n = 14), Tabata - Overweight (n = 11), and Control - Overweight (n = 12). There are three classifications of BMI according to WHO criteria: normal weight (18.5–24.9), overweight (≥25) [11]. Inclusion criteria for the current study include females aged 20–25 years; normal weight or overweight; no structured physical activity (>1 session/week) in the previous three months; no performance-enhancing supplements or medications; no cardiovascular, metabolic, or musculoskeletal conditions; and written consent. Injury or illness onset during intervention, poor compliance, or the initiation of medication or supplement use during study are exclusion criteria.

Ethics and registration

This study was approved by the Ethics Committee of Islamic Azad University, Science and Research Branch (IR.IAU.SRB.REC.1403.359), and registered at the Iranian Registry of Clinical Trials (IRCT20241229064200N1).

Assessment of anthropometrics and body composition

SECA stadiometers (Germany, accuracy: 0.1 cm) were used to measure height, and InBody 370 analyzers were used to assess body composition parameters (weight, body mass index, body fat percentage, and skeletal muscle mass) under standard conditions: fasting for 8-12 hours, avoiding caffeine (12 hours), emptying bladders, and no vigorous activity within 24 hours [12].

Physical Fitness Assessments

The Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1) is used to estimate VO2max [13], the shuttle run test is used to measure agility, the Stork Stand Test [15], the Sargent Vertical Jump Test is used to test explosive power [16], and the Sit-and-Reach test is used to test flexibility [17]. Using validated protocols, all tests were conducted by a trained evaluator.

Intervention Protocol

With three sessions per week (50–55 minutes/session), the Tabata group performed an 8-week high-intensity interval training (HIIT) program based on the classic Tabata structure. There was a 10--12-minute warm-up (light jogging, mobility, dynamic stretches), followed by 3 to 5 rounds of Tabata intervals (8 x 20 s maximal effort / 10 s rest), followed by a 1-minute passive recovery between rounds. Over the course of the intervention, training volume increased. To maintain 75–85% HRmax, Polar H10 sensors monitored heart rate. Adapted exercises minimize joint stress for overweight participants while maintaining training intensity (e.g., low-impact alternatives to jumping movements). Table 1 summarizes the Tabata intervention protocol.

Table 1. Tabata Training Protocol Across the 8-Week Intervention Period

Weeks	Rounds per Session	Selected Exercises	Reference
Weeks 1–2	3 rounds (12 min)	Narrow-stance squats, butt kickers, toe touches, lunges, mountain climbers, jumping jacks, abdominal twists, squat to side	[21]
Weeks 3–4	4 rounds (16 min)	Jumping jacks, squat jumps, mountain climbers, plank jacks, high knees, push-ups, bicycle crunches, seal jacks	[22]
Weeks 5–6	4 rounds (16 min)	Same as Weeks 1–2	[21]
Weeks 7–8	5 rounds (20 min)	Same as Weeks 3–4	[22]

Statistics model

The data are presented as the mean and standard deviation. First, the assumptions of repeated measures analyses of variance were tested, including the normality of the data distribution and the homogeneity of variances. This was done using Kolmogorov-Smirnov and Levene's tests, respectively. Then, a repeated measure ANOVA was conducted to analyze results. According to this model, the effects of time, group, and the time*group interaction on the study outcomes were examined. In cases where a significant difference was observed, the Bonferroni post-hoc test was applied. To better understand the magnitude of the observed effects, within-group changes were also compared using the paired T-test. The significance level for all analyses was set at $p<0.05$. All calculations were performed using SPSS version 22.

3. Results

Analysis of body weight revealed no significant main effect on time ($F(1,48) = 1.69$, $P = 0.200$, $\eta^2 = 0.034$). However, the time × group interaction reached significance ($F(3,48) = 6.67$, $P = 0.001$, $\eta^2 = 0.294$), indicating that changes over time varied by group. Bonferroni post-hoc tests showed a statistically significant reduction in body weight exclusively in the overweight Tabata group ($P = 0.006$) (see Table 2).

For $F(1,48)$or body mass index (BMI), the ANOVA yielded the significant main effect of time ($F(1,48) = 5.96$, $P = 0.017$, $\eta^2 = 0.111$), and the interaction between time and group was also significant ($F(3,48) = 3.02$, $P = 0.029$, $\eta^2 = 0.159$). However, the between-group main effect was not significant ($P = 0.101$), suggesting that BMI changes over time differed across groups but not between groups at baseline.

Regarding body fat percentage, significant main effects were observed for time ($F(1,48) = 7.57$, $P = 0.009$, $\eta^2 = 0.136$) and group ($F(3,48) = 2.98$, $P = 0.042$, $\eta^2 = 0.157$), as well as a significant time × group interaction ($F(3,48) = 3.73$, $P = 0.015$, $\eta^2 = 0.189$). These findings indicate that tabata training, particularly among overweight participants, reduces fat mass (see Figure 1 and Table 2).

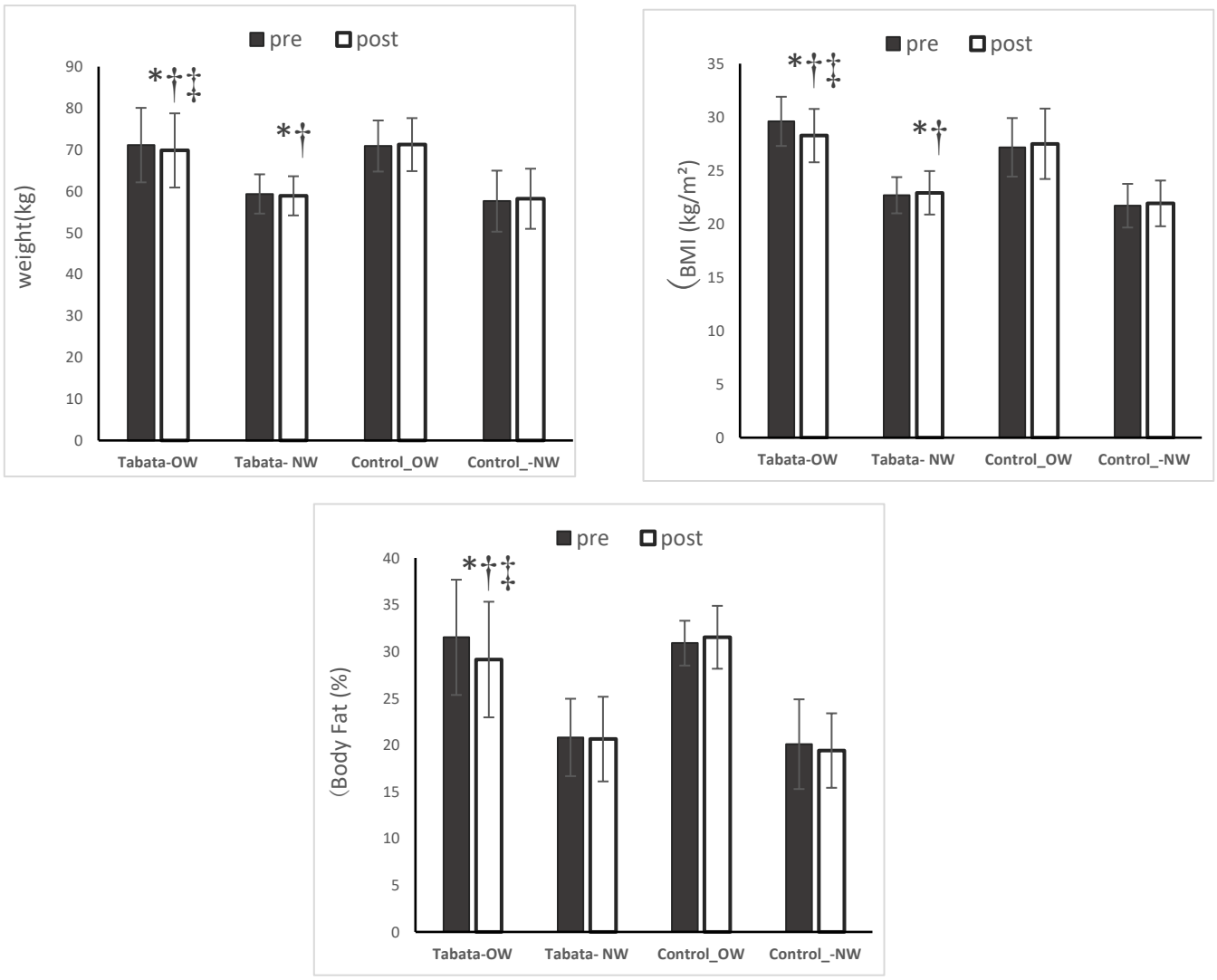


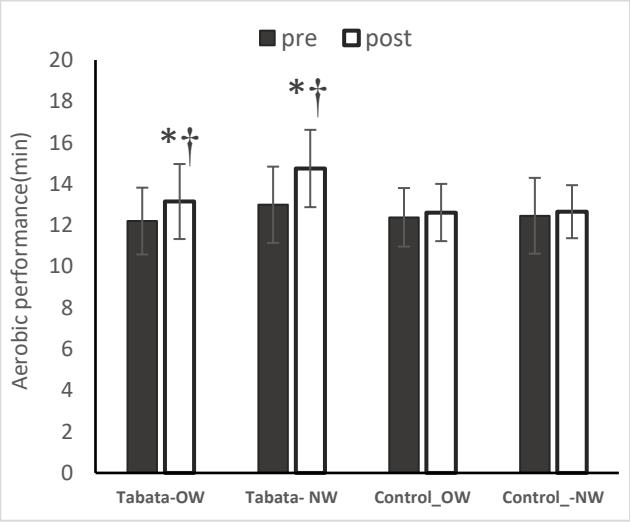
Figure 1. Changes in Body Weight, BMI and Body Fat percent in the following groups: Tabata training–overweight girls, Tabata training-normal weight girls, overweight–control girls, and normal weight–control girls. *Indicates a significant difference from the pre-test. †Indicates a significant difference compared with the control group. ‡Indicates a significant difference in its changes compared to the Tabata training–normal weight group. Data were analyzed using repeated measures ANOVA. $P < 0.05$ was considered statistically significant. Data are reported as mean and standard deviation.

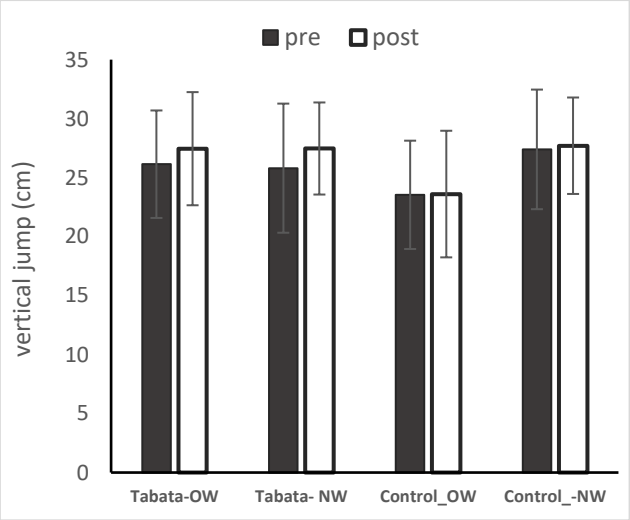
aerobic capacity (VO_2max), a significant effect of time ($F(1,48) = 5.50$, $P = 0.021$, $\eta^2 = 0.125$) and a significant time × group interaction ($F(3,48) = 2.87$, $P = 0.047$, $\eta^2 = 0.151$) were detected. Notably, the most pronounced VO2max improvements were documented in the overweight Tabata group (see Figure 2 and Table 3).

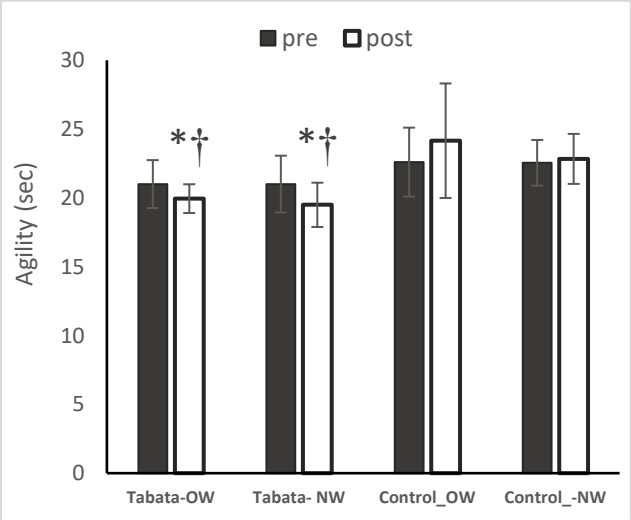
In contrast, the vertical jump performance did not change significantly. No main effect of time ($P = 0.106$), group ($P = 0.320$), or time × group interaction ($P = 0.312$) was observed, indicating that the intervention had no meaningful influence on explosive lower-body power.

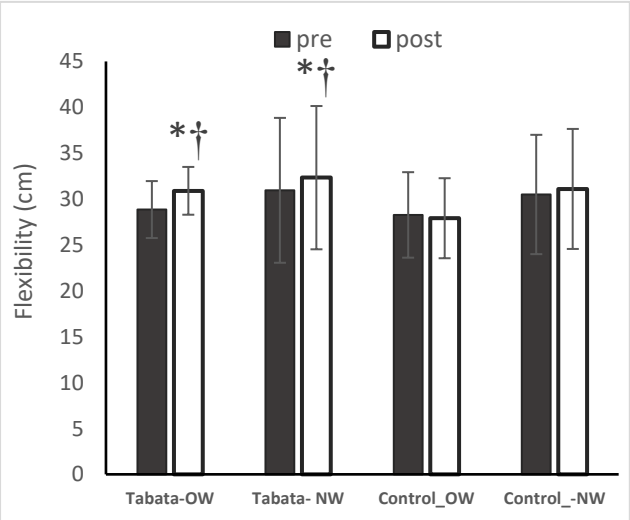
Similarly, agility performance showed no significant alterations over time. The analysis revealed no main effect of time (P = 0.122), group (P = 0.296), or interaction (P = 0.281), suggesting that Tabata training did not significantly impact agility.

The Tabata intervention improved body composition parameters (BMI and body fat percentage) and cardio-respiratory fitness (VO2max), especially in overweight female students. The training protocol, however, had little effect on neuromuscular performance indicators, such as agility and vertical jump.









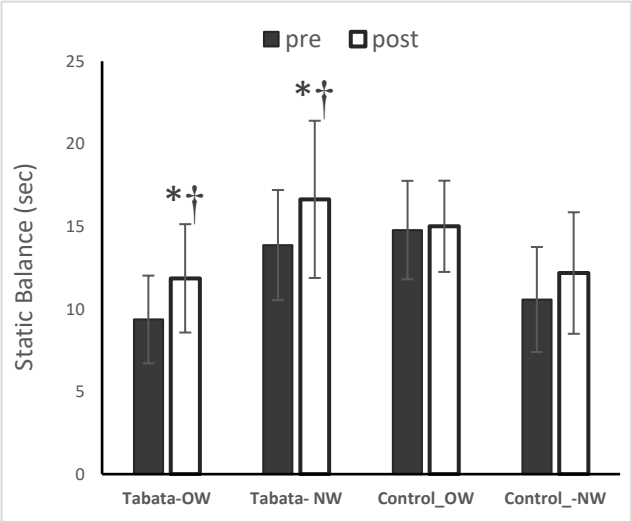


Figure 2. Changes in Aerobic performance, vertical jump, Agility, Flexibility and Static balance in the following groups: Tabata training–overweight girls, Tabata training-normal weight girls, overweight–control girls, and normal weight–control girls. *Indicates a significant difference from the pre-test. †Indicates a significant difference compared with the control group. ‡Indicates a significant difference in its changes compared to the Tabata training–normal weight group. Data were analyzed using repeated measures ANOVA. P < 0.05 was considered statistically significant. Data are reported as mean and standard deviation.

4. Discussion

Female university students categorized by weight status were evaluated for their physical fitness and body composition after Tabata high-intensity interval training (HIIT). Among overweight participants, the eight-week intervention led to significant improvements in aerobic capacity, body composition, flexibility, and static balance. A significant improvement in VO2max was observed in the overweight Tabata group (P = 0.047), which is consistent with HIIT mechanisms previously reported.

Within the overweight Tabata group, body weight, BMI, and fat percentage significantly decreased. A 5.37% decrease in body fat was also achieved. Even without muscle hypertrophy, HIIT stimulates excess post-exercise oxygen consumption (EPOC), growth hormone release, and lipolysis [25, 26]. In contrast, no significant changes in muscle mass were observed, which is consistent with HIIT protocols focusing on aerobic demands. The agility and vertical jump outcomes showed some descriptive improvement, but statistical significance was not achieved (P > 0.05). Possibly, this is due to inadequate pre-plyometric loading or the sensitivity of the tests used [28]. Conversely, balance and flexibility improved significantly, possibly due to warm-up and cool-down routines that included mobility and stretching, corroborating evidence of HIIT's neurological benefits [29, 30].

Applying HIIT to overweight populations requires attention to joint safety. Low-impact exercises, such as step-touch exercises or grounded knees, can reduce joint stress while maintaining training intensity. In similar demographics, this approach has been shown to improve aerobic function without increasing joint pain [31]. In addition to being both safe and effective, adapted HIIT is recommended by the American College of Sports Medicine and observational studies [32, 33].

As a whole, the results indicate that customized Tabata programs can deliver comprehensive fitness improvements within academic and low-resource settings while maintaining safety and feasibility.

Study Limitations:

1. The small sample size and restriction to female students may limit generalizability.
2. The intervention lacked the strength or plyometric components necessary for muscle hypertrophy.
3. Long-term follow-up was not conducted to assess adaptation retention.
4. Field-based assessments were used instead of gold-standard laboratory methods.

Future directions

• Combine HIIT with resistance training to target muscle growth and power.
• Investigate the hormonal and inflammatory biomarkers linked to HIIT.
• Explore psychological effects and motivation in young female participants.
• Conduct longitudinal studies to examine the persistence of benefits.
• Provide services to diverse populations across genders and age groups.

5. Conclusion

Tabata training emerged as a time-efficient and effective method of improving health metrics among overweight female students. While notable improvements occurred in fat loss, aerobic capacity, and functional mobility, integrating resistance training could optimize outcomes in strength and agility. These insights can support targeted interventions in university

Acknowledgements

The authors thank the participating students at Islamic Azad University, Qazvin Branch, for their dedication. Appreciation is also extended to the Qazvin Sports Medicine Board President for accessing testing facilities. Ethics approval and consent to participate: Approved by the Ethics Committee of Islamic Azad University, Science and Research Branch (Ethics Code: IR.IAU.SRB.REC.1403.359). All participants consented

Funding

This study did not have any funds.

Compliance with ethical standards

Conflict of interest None declared.

Ethical approval the research was conducted with regard to the ethical principles.

Informed consent Informed consent was obtained from all participants.

Author contributions

Conceptualization: Z.M, F.GH, SH.S ; Methodology: Z.M, F.GH, SH.S. ; Software: Z.M, F.GH, SH.S ; Validation: Z.M, F.GH, SH.S ; Formal analysis: Z.M, F.GH, SH.S ; Investigation: Z.M, F.GH, SH.S ; Resources: Z.M, F.GH, SH.S ; Data curation: Z.M, F.GH, SH.S ; Writing - original draft: Z.M, F.GH, SH.S ; Writing - review & editing: Z.M, F.GH, SH.S ; Visualization: Z.M, F.GH, SH.S ; Supervision: Z.M, F.GH, SH.S ; Project administration: Z.M, F.GH, SH.S; Funding acquisition : Z.M, F.GH, SH.S .

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