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Original Research

Health and Fitness Comparisons Among Middle-Aged and Older Adults with Long-Term Participation in Four Different Sports

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ABSTRACT

International Journal of Exercise Science 15(6): 1028-1039, 2022. Physical activity is known to confer numerous health benefits. However, few studies have assessed the prolonged impact of participation in different sports on health and fitness. The purpose of this cross-sectional study was to compare the impact of long-term participation (i.e., ≥9 years) in four different sports, including two traditional Chinese (Tai Chi; diabolo) and two modern sports (aerobics; track and field [TF]) on health and fitness measures among middle-aged and older adults. Participants (n=252, 56.6±8.5y, 66% female) completed the following measures: height, weight, BMI, waist circumference, waist-hip ratio (WHR), body fat%, resting blood pressure (BP) and heart rate, vital capacity, grip strength, reaction time, flexibility, balance. Compared to Tai Chi, aerobics was associated with lower systolic BP and fat%, and greater vital capacity, while TF was associated with lower systolic BP, shorter reaction time, greater vital capacity and better balance (p-values<0.05). Diabolo was associated with lower WHR compared to aerobics and Tai Chi, and greater vital capacity than Tai Chi (p-values<0.05). No significant differences were observed across sports in other measures. Long-term participation in four sports might have different effects on BP, vital capacity, balance, reaction time, body fat, and central adiposity. Individuals who prefer to choose traditional sports (Tai Chi, diabolo) may anticipate similar long-term effects on resting heart rate, BMI, muscle mass, and grip strength compared to those who perform modern sports (aerobics, TF). Information presented in this study may be valuable when designing population, group and individually-tailored PA recommendations in culturally diverse individuals.

KEY WORDS: Tai Chi, sports, physical fitness, health, exercise

INTRODUCTION

Population aging has become a public health challenge worldwide. By 2050, the number of people aged 65 years and older is projected to reach over 1.5 billion (27). Common diseases associated with aging (e.g., cardiovascular diseases, metabolic syndrome) lead to low quality of

life and increase the burden on health care and social support systems (1, 27). To reduce disease-related risk factors (e.g., obesity, hypertension) and preserve physical independence (17, 29), current public health guidelines recommend that middle-aged and older adults participate in regular physical activity (PA) (30).

PA behaviors may be influenced by various factors, including cultural background, neighborhood environment, personal preferences, and accessibility (28). Recently, traditional Chinese sports (*for the purposes of this study, "sport" is used as an inclusive term for individual and group competitive and non-competitive exercise activities*) are becoming increasingly popular both in China and worldwide (15, 23). For example, Tai Chi is a well-known traditional form of "mind-body" activity that combines both physical and mental components. In 2018, there were 3.7 million individuals practicing Tai Chi in the United States (21). Diabolo (or kong zhu) is a traditional type of Chinese Yo-Yo exercise that also appeals to a growing number of people of all ages (23). Other types of group- or community-based activities (e.g., square dancing) and peer-led interventions (i.e., instructors with similar characteristics) are also regarded as efficient ways to promote PA adherence among middle-aged and older adults (6, 12). Importantly, these activities or sports require low cost and have the potential to meet both cultural and social demands for community-dwelling or culturally diverse individuals, which may also contribute to exercise engagement and overcome barriers to participating in regular PA, especially for females and older adults (2, 5, 7). Moreover, previous research has indicated some favorable effects of those traditional sports (e.g., Tai Chi) on health outcomes such as improving balance and strength (16), which would be particularly beneficial for reducing the risk of falls and promoting the functional ability for activities of daily living.

However, these potential promotors to PA participation regarding cultural sensitivity and social aspects have not received enough attention in public health programs (15). Consequently, there is a lack of evidence regarding the prolonged health effects of participating in culturally relevant sports among the general population, and the potential differences or similarities in the health impact of traditional versus modern forms of activity (e.g., track and field) (4, 20). At present, few studies reported that short-term Tai Chi interventions (8 weeks~1 year) improved mobility and quality of life in both healthy and chronically ill individuals (1, 11, 33); while limited evidence suggested that practicing diabolo was associated with increased balance and reaction time (16). To the best of our knowledge, no study examined the potential differences in health and fitness measures resulting from long-term participation (i.e., over multiple years) in these culturally relevant sports, especially for diabolo. The lack of research on comparisons of sports that purposefully combine multiple components (e.g., physical, mental, or cultural) might be attributable to inadequate sample size (e.g., difficult to recruit older adults performing diabolo), and possible challenges to evaluating the contribution of either component by itself (1). Additionally, considering the compensatory adaptations in metabolic and behavioral responses superimposed during interventions over relatively short time periods (10, 18), the generalizability of the health impact(s) observed from short-term interventions might be limited for long-term exercise participation. Thus, evaluating the effects of habitual or prolonged

participation in various types of exercise is required to elucidate the chronic PA-related benefits and facilitate public health application.

Therefore, the purpose of this study is to compare the effects of long-term participation (i.e., ≥ 9 years) in four sports, including two traditional Chinese sports (Tai Chi; diabolo) and two modern sports (aerobics; track and field [TF]) on health and fitness measures (i.e., weight, BMI, waist circumference, waist-hip ratio [WHR], body fat, resting blood pressure and heart rate, vital capacity, grip strength, reaction time, flexibility and balance) among Chinese middle-aged and older adults. Such evidence may help inform individuals who are seeking a culturally relevant sport that also provides specific health benefit(s) equivalent to or beyond modern exercises (e.g., aerobics, track and field), and could also be an essential consideration when designing population or group and individually-tailored PA recommendations for successful aging, while also considering cultural factors, adherence and enjoyment.

METHODS

Participants

The current study was a secondary data analysis of a research project funded by the Education Department of Henan Province (China) in 2016 (No. 2016GGJS-207). A detailed description of the larger project and results are published elsewhere (23). Briefly, the original sample included 365 qualified National Social Sports Instructors (NSSIs) who performed one or more sport specialties (e.g., Tai Chi) for at least nine years (13). Eligible participants were 1) free from injury, illness, or disability that might impact study measurements, 2) not taking medications that would have affected the physical fitness measures, and 3) not engaging in moderate-to-vigorous physical activities on the day of measurement. The initial eligibility screening, written informed consent, and data collection were conducted at the training facility for NSSIs in 2016 and 2017. All protocols and procedures were approved by the local institutional review board. This research was carried out fully in accordance with the ethical standards of the International Journal of Exercise Science (19).

Individuals who were aged less than 45 years or had incomplete data were removed from the dataset (n = 113). The final analytical sample was composed of 252 participants (mean age 56.6 ± 8.5 years; 66% females). Due to the variety of performed sport disciplines and idioms used by the participants, the present analysis categorized sports into four main categories according to similar patterns, branches, and/or cultural factors: Aerobics (aerobic dancing, square dancing, aerobics); Diabolo (diabolo or Chinese Yo-Yo); Tai Chi (Tai Chi Quan, Qigong, Kungfu); Track and Field (track events, field events and combined events). Note, among the TF group, 80% of participants engaged in more than one or combined events, whereas only two participants reported their sport or activity as running only.

Protocol

Participants completed a questionnaire on health and medication history to assess eligibility for this study. Following eligibility screening and consent, basic demographic information was

collected, including age, sex, and the specific sports they performed. Next, all participants completed the following physical fitness measures under the supervision of trained research assistants.

Upon arrival, participants were required to sit quietly and rest for 15 minutes prior to blood pressure measurement. Resting blood pressure (mmHg) and heart rate (beats/min) were measured by an automated blood pressure monitor (OMRON HEM-1000, OMRON Healthcare Co., Ltd, China), and the average of three measures was calculated. Next, height (cm), weight (kg), vital capacity (mL), grip strength (kg), reaction time (ms), waist and hip circumferences (cm), flexibility (cm) and balance (s) were measured using standardized (manualized) procedures on a series of digital test instruments (5000 series, TSINGHUA TONGFANG Co., Ltd, China). Waist circumference was measured at the narrowest point between the lower costal border and iliac crest, while hip circumference was measured at the widest portion of the buttocks. For height, weight, vital capacity, waist circumference and hip circumference, two measurements were taken to ensure accuracy, with a third measurement required if the first two differed by > 0.3 cm, 0.5kg, or 150mL. Body mass index (BMI, kg/m^2) and waist-hip ratio (WHR) were calculated as additional variables of interest. For flexibility, balance and grip strength, each measure was repeated three times and the highest value or best performance was recorded as the final result. Specifically, flexibility (cm) was measured by the sit-and-reach test, balance (s) was obtained by the unipedal balance test with eyes closed, and grip strength was tested using a hand dynamometer (3, 24). For the reaction time measure, participants stood in front of a digital tester while holding the start button. Next, they were required to pay attention to the lights on other buttons, and to press the correct button as quickly as possible when the light was switched on. After several moves, the final result (in milliseconds [ms]) displayed on the screen was recorded for further analysis. Finally, body composition was measured by a bioelectrical impedance analyzer (T-SCAN PLUS II, SELVAS Healthcare, Inc., Korea), including body fat percentage (fat%) and muscle mass (kg).

Statistical Analysis

All analyses were performed in *R* (version 4.0.2) with the α level set at 0.05. Analyses of covariance (ANCOVA) were used to compare the effects of the different sports on health and fitness measures, while controlling for sex as a covariate. The health and fitness measures (dependent variables) included resting heart rate (HR), resting systolic (SBP) and diastolic blood pressure (DBP), weight, BMI, waist circumference, waist-hip ratio (WHR), body fat percentage (fat%), muscle mass, vital capacity, flexibility, balance, reaction time, and grip strength.

Collected data were summarized as mean ± standard deviation (SD), range (min-max) or mean (95% confidence intervals [95% CIs]) by sex or sport category where appropriate. The 95% CI's were interpreted as significantly different if there was no overlap between confidence intervals, and not significantly different if the confidence interval for one group overlapped the mean of the other group (14). Attributable to the fact that no significant interaction effects were observed across sport types and sex in all dependent variables (*p*-values > 0.05), the effect of sex was adjusted by computing least-squares means to balance the number of males and females in each

group. Furthermore, post-hoc pairwise comparisons were performed using Tukey's HSD tests to examine the effects of different sport types while controlling for the potential effects of sex. The data were checked for violations against the assumptions for ANCOVA. In particular, the normality assumption within groups and the homogeneity of variances between groups were assessed for each health and fitness measure by using Shapiro-Wilk tests and Levene's Test, respectively. For measures that were not normally distributed (SBP, WHR, Balance, Reaction time), log transformations were performed prior to conducting ANCOVA analyses to obtain *F* statistics, *t* ratios and *p* values; however, mean differences (*d*) and standard errors (SE) were calculated using original values (units) for ease of the interpretation of the results.

RESULTS

Sample demographics, anthropometrics, health and fitness measures (mean ± SD, range [min-max]) for the whole sample and sex groups were summarized in Table 1. In general, males and females appeared to have similar mean resting HR and WHR, but differed across other health and fitness measures.

Table 1. Descriptive characteristics of the analyzed sample

Measures	Female (n=167)		Male (n=85)		Total (n=252)	
	Mean ± SD	Min – Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max
Age (years)	57.3±7.7	45.0–75.0	55.2±9.9	45.0–75.0	56.6±8.5	45.0–75.0
HR (beats/min)	74.2±9.5	48.0–116.0	75.1±10.6	52.0–110.0	74.5±9.9	48.0–116.0
SBP (mmHg)	125.3±22.9	85.0–193.0	133.1±20.2	106.0–218.0	127.8±22.3	85.0–218.0
DBP (mmHg)	70.1±13.2	40.0–118.0	76.4±11.2	52.0–110.0	72.2±12.9	40.0–118.0
Weight (kg)	59.2±8.2	42.9–93.4	74.0±8.0	55.7–91.2	63.8±10.6	42.9–93.4
BMI (kg/m^2)	22.8±2.7	16.6–32.3	25.0±2.5	18.6–31.9	23.5±2.8	16.6–32.3
Waist (cm)	83.6±8.9	65.0–107.0	92.0±6.9	76.0–105.5	86.0±9.2	65.0–107.0
WHR	0.85±0.06	0.65–0.97	0.82±0.06	0.60–0.90	0.84±0.06	0.6–1.0
Body fat (%)	26.1±6.1	11.3–38.0	17.1±4.3	6.7–25.5	23.5±7.0	6.7–38.0
Muscle mass (kg)	40.0±3.4	33.8–52.1	58.1±5.3	47.0–70.4	45.7±9.4	33.8–70.4
Vital capacity (mL)	2203.4±628.0	780.0–3844.0	3531.0±843.3	1623.0–5325.0	2651.6±945.8	780.0–5325.0
Flexibility (cm)	17.86±6.3	1.6–32.5	13.9±7.8	0.0–29.0	16.6±7.0	0.0–32.5
Balance (s)	17.8±22.8	1.8–150.4	20.2±23.9	1.8–112.0	18.6±23.1	1.8–150.4
Reaction time (ms)	683.1±160.7	440.0–1550.0	618.6±116.0	170.0–930.0	662.3±150.6	170.0–1550.0
Grip strength (kg)	26.7±18.4	11.9–240.0	53.1±50.0	26.0–368.0	35.5±34.8	11.9–368.0

Note: HR = resting heart rate; SBP = systolic blood pressure; DBP = diastolic blood pressure; BMI = Body mass index; WHR = Waist-hip ratio; SD = standard deviation.

Overall, the analyses revealed significant main effects of sport type on SBP, WHR, body fat percentage, vital capacity, balance, and reaction time (*p*-values < 0.05). No significant differences were found across sports for DBP, waist circumference, weight, and BMI (*p*-values > 0.05). The sex-adjusted means (95% CIs) for all measures are provided in Table 2.

Systolic blood pressure (SBP): The analysis revealed a significant main effect of sport type on SBP, $F(3, 243) = 4.63$, $p = 0.0036$. Moreover, the post-hoc pairwise comparisons indicated that, after controlling for sex, the mean SBP for Tai Chi was significantly higher than that for Aerobics ($d = 9.09$ mmHg, $t(243) = -2.97$, $p = 0.02$) and TF ($d = 13.88$ mmHg, $t(243) = -2.62$, $p = 0.046$). In other words, Aerobics and TF may contribute to a lower blood pressure compared to Tai Chi. No significant differences in mean SBP were observed among the other sports ($p > 0.05$).

Table 2. Sex-adjusted means and 95% CI's for health and fitness measures across sports (mean [95%CI])

Measures	Aerobics (n = 78)	Diabolo (n = 30)	Tai Chi (n = 119)	TF (n = 25)
HR (beats/min)	72.7 (70.1, 75.2)	72.7 (69.0, 76.4)	75.9 (74.1, 77.8)	75.6 (71.5, 79.6)
SBP (mmHg)	125 (120, 131)*	126 (118, 134)	134 (130, 139)	121 (112, 129)*
DBP (mmHg)	73.2 (70.0, 76.4)	72.1 (67.3, 76.8)	74.0 (71.6, 76.4)	71.6 (66.5, 76.7)
Weight (kg)	66.5 (64.3, 68.8)	68.7 (65.6, 71.8)	65.5 (63.8, 67.1)	69.5 (64.8, 74.1)
BMI (kg/m²)	23.7 (23.0, 24.5)	24.2 (23.1, 25.2)	23.8 (23.3, 24.4)	24.4 (22.9, 25.9)
Waist (cm)	86.6 (84.2, 89.1)	86.5 (82.6, 90.4)	89.6 (87.8, 91.5)	82.9 (77.9, 87.8)
WHR	0.845 (0.829, 0.860)†	0.810 (0.790, 0.830)*	0.841 (0.829, 0.852)	0.836 (0.804, 0.868)
Body fat (%)	19.8 (18.4, 21.2)*	22.4 (20.2, 24.6)	22.3 (21.2, 23.5)	22.3 (19.1, 25.5)
Muscle mass (kg)	49.2 (48.1, 50.4)	50.6 (49.1, 52.2)	48.1 (47.3, 49)	51.1 (48.8, 53.5)
Vital capacity (mL)	2893 (2724, 3062)*	3101 (2851, 3351)**	2612 (2487, 2737)	3557 (3276, 3837)**
Flexibility (cm)	14.1 (12.1, 16.1)	14.5 (11.2, 17.7)	16.9 (15.5, 18.3)	16.7 (12.7, 20.7)
Balance (s)	18.5 (12.4, 24.6)	19.4 (10.7, 28.2)	14.7 (10.3, 19.1)	38.7 (28.1, 49.4)**
Reaction time (ms)	630 (590, 669)	669 (614, 725)*	679 (650, 707)	542 (473, 612)**
Grip strength (kg)	38.8 (30.2, 47.4)	35.3 (22.9, 47.8)	41.7 (35.4, 48.0)	40.2 (26.2, 54.1)

Note: Data are presented as mean (95%CI). * $p < 0.05$, ** $p < 0.01$, significantly different compared to Tai Chi group. † $p < 0.05$, significantly different compared to Diabolo group. HR = resting heart rate; SBP = systolic blood pressure, DBP = diastolic blood pressure, WHR = Waist-hip ratio, BMI = Body mass index, SD = standard deviation, TF = Track and field, 95% CI = 95% confidence interval.

Waist-hip ratio (WHR): A significant main effect of sport type on WHR was observed, $F(3, 198) = 2.97$, $p = 0.033$. After controlling for sex, post-hoc pairwise comparisons revealed that mean WHR for Diabolo was significantly lower than that for Aerobics ($d = -0.034$, $t(198) = -2.78$, $p = 0.03$) and Tai Chi ($d = -0.031$, $t(198) = -2.77$, $p = 0.03$). No significant differences in mean WHR were detected among the other sports ($p > 0.05$).

Body fat percentage (%fat): A significant main effect of sport type on %fat was identified, $F(3, 211) = 3.14$, $p = 0.026$. Post-hoc pairwise comparisons indicated that, after controlling for sex, the mean %fat for Aerobics was significantly lower than that for Tai Chi ($d = -2.53\%$, $t(198) = -2.94$, $p = 0.02$). No significant differences in the mean %fat were observed among the other sports ($p > 0.05$).

Vital capacity: We also found a significant main effect of sport type on vital capacity, $F(3, 232) = 13.94$, $p < 0.001$. Post-hoc pairwise comparisons revealed that the mean vital capacity for Tai Chi was significantly lower than that for Aerobics ($d = -281$ mL, $t(232) = -2.80$, $p = 0.028$), Diabolo ($d = -489$ mL, $t(232) = -3.41$, $p = 0.004$), and TF ($d = -945$ mL; $t(232) = -5.94$, $p = 0.0001$), after

controlling for sex. In other words, the other sport categories demonstrated higher a vital capacity compared to the Tai Chi group. In addition, the mean vital capacity for TF was significantly greater than Aerobics (d = 664 mL, $t(232)$ = 3.85, p = 0.001). No significant differences in mean vital capacity were found among the other sports ($p > 0.05$).

Balance: A significant main effect of sport type on balance was reported, $F(3, 216) = 6.38$ p = 0.00037. Post-hoc pairwise comparisons revealed that, after controlling for sex, the mean balance time for TF was significantly longer than that for Tai Chi (d = 23.99 s, $t(216)$ = -4.01, p = 0.0004), indicating better balance in TF. Although the mean time for TF was also longer than that for Aerobics, the difference was not significant (d = 20.22 s, $t(216)$ = -2.58, p = 0.051). No significant differences in balance were found among the other sports ($p > 0.05$).

Reaction time: We observed a significant main effect of sport type on reaction time, $F(3, 212)$ = 5.57, p = 0.0011. Post-hoc pairwise comparisons demonstrated that, after controlling for sex, the mean reaction time for TF was significantly shorter than that for Diabolo (d = -127.14 ms, $t(212)$ = -3.15, p = 0.01) and Tai Chi (d = -136.25 ms, $t(212)$ = -3.74, p = 0.001), indicating a better performance in TF. No significant differences in reaction time were found among the other sports ($p > 0.05$).

Figure 1 displays the comparisons of significant measures by sport category, including SBP, WHR, body fat%, vital capacity, balance, and reaction time, where points and bars represent sex-adjusted means and 95%CIs, respectively.

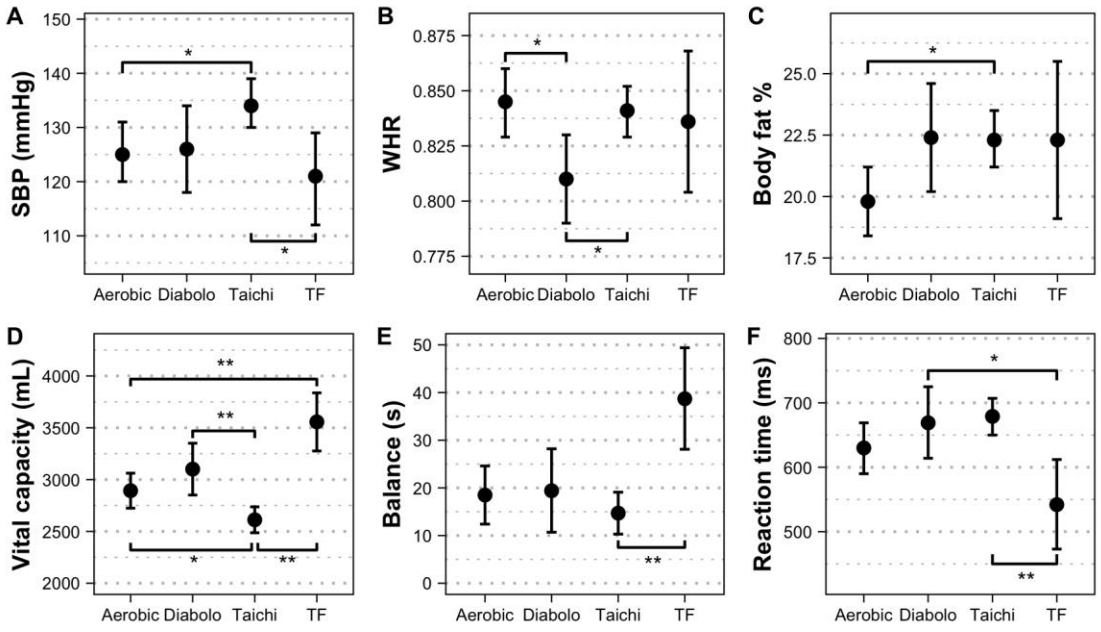

Figure 1. Comparisons of SBP, WHR, Body fat percentage, Vital capacity, Balance, and Reaction time by sport type. Points represent sex-adjusted mean values, and error bars represent the 95% confidence intervals. * p <0.05, ** p <0.01. BMI = Body mass index, SBP = systolic blood pressure, TF = Track and field, WHR = Waist-hip ratio.

DISCUSSION

The primary aim of the current study was to compare the long-term effects (i.e., at least nine years) of four types (or categories) of sports (i.e., aerobics, diabolo, Tai Chi, TF) on health and fitness measures among middle-aged and older adults. Herein, we reported that long-term participation in four sports might have different effects on BP, vital capacity, balance, reaction time, body fat and central adiposity. Compared to Tai Chi, long-term participation in aerobics was associated with lower SBP and body fat percentage and greater vital capacity, while TF was associated with lower SBP, shorter reaction time, greater vital capacity and better balance. Interestingly, diabolo, a traditional Chinese sport, demonstrated a favorable effect on central adiposity (waist-hip ratio) compared to aerobics and Tai Chi, and was also associated with greater vital capacity than Tai Chi. However, we did not observe a significant main effect of sports on resting HR, BMI, muscle mass and grip strength, indicating that performing the four sports might have equivalent effects on these health and fitness measures. Thus, individuals who prefer to choose traditional Chinese sports (diabolo or Tai Chi) may anticipate similar long-term benefits on resting heart rate, BMI, muscle mass, and grip strength compared to modern sports (aerobics and TF).

Differences in the prolonged effects of the four sports categories might be attributed to distinct characteristics such as activity pattern, training style, and different levels of engagements of body segments (9). Although the intensity of Tai Chi is determined by styles (e.g., Yang's style, 24-style) and training patterns (e.g., speed, or competitive form), it is commonly considered as moderate-intensity aerobic exercise (32), which is similar to the aerobics category included in this study (31). Diabolo requires the participant to spin, balance, throw and catch an hourglass-shaped object using a string stretched between the tips of two hand-held sticks, and these tasks involve both upper and lower limbs and rely on muscular strength, balance and coordinated motor activities, especially during advanced tricks (e.g., interaction or competition with partners) (15, 23). The distinct features of exercises and individualized practicing methods may lead to varying effects on the health and fitness measures examined in this study. The diverse health benefits of various sports were previously demonstrated in a systematic review by Guo et al. (16). In their review, six cross-sectional studies reported Tai Chi was associated with improved balance, flexibility, walking ability, muscular strength and quality of life, while only five controlled (4 nonrandomized, 1 randomized) studies reported that 6- to 11-month diabolo trainings improved balance, grip strength, blood cholesterol and sleep quality (16). In the current study, the four sports had significantly different effects on BP, vital capacity, balance, reaction time, body fat and central adiposity. On the other hand, a possible reason for the lack of differences in other health and fitness measures is that participants in most groups might have already acquired similar health benefits from prolonged sport participation, and thus it was less likely to detect significant differences among individuals with such chronic adaptations (e.g., similar BMI in each sport group).

To date, there is limited evidence comparing the health impacts of traditional versus modern forms of exercise. Chan et al. (8) compared three-month Tai Chi training and brisk walking, and

found that individuals in the Tai Chi group had a greater reduction in blood pressure (d = -12.46 [systolic] and -3.20 [diastolic] mmHg; $p < 0.001$ and $p = 0.049$, respectively) and blood glucose (-1.27 mmol/L, $p = 0.001$) compared to the walking group. Another study by Taylor-Piliae et al. (25) investigated the effects of 6-month western exercise (i.e., incorporated endurance, resistance/strength and flexibility trainings) and Tai Chi training in healthy older adults. Specific to physical functioning, they found that Tai Chi significantly improved balance (single-leg stance test; d = 0.54 s [0.4, 10.7]) than control group ($p = 0.038$), but the effects were not different from western exercise ($p > 0.05$); whereas western exercise had a better effect on upper body flexibility compared to Tai Chi (back-scratch test; d = 2.9 cm [0.4, 5.4], $p = 0.011$). However, the current study did not find better health effects of Tai Chi compared to the other three sports – lower vital capacity, greater SBP, WHR, body fat and reaction time were observed in the Tai Chi group ($p < 0.05$). One potential explanation is that the current study examined cross-sectional associations for individuals with prolonged involvement in these sports, and therefore might be more reflective of the prolonged effects, which could be different from previous studies regarding short-term (3~6 months) changes in health outcomes accompanied with potential compensatory adaptations (10). Further, the current study only included limited types of sport practiced by participants in the analytic sample, which might also lead to different results from the comparisons with other PA modalities such as walking. Future studies are needed concerning the health benefits of more types of sport, especially comparing those increasingly popular traditional versus modern sports.

Moreover, the inconsistencies among previous findings might also relate to the differences in cultural and social factors, adherence and enjoyment. As alluded to above, despite insufficient evidence in evaluating different racial/ethnic groups or programs, these characteristics of exercise participation (e.g., forms, elements) may cause dissimilarities in the effectiveness of exercise interventions (5). For example, peer-led interventions (e.g., instructors with similar characteristics) were shown to be more effective in older adults and individuals with chronic diseases (e.g., multiple sclerosis, arthritis, diabetes) (1). Indeed, aerobics (e.g., square dancing) and Tai Chi groups depicted in this study were most likely performed in community or group settings. These activities may be more attractive to potential participants who are sensitive to specific levels of sex, age and culture, which leads to increased exercise participation and enjoyment (8, 26) and consequently greater PA-related health benefits. Our results align with such statements, indicating several favorable effects on SBP and body fat in the aerobics group. Nevertheless, the current study did not include information about different forms of sport participation (e.g., personal or group-based). There is a need for future research and public health guidelines to properly account for the variations in PA behaviors among different populations, while also considering the social and cultural potentials of various exercise modalities. Such information would be beneficial for comprehensive PA and health programs to increase adherence (22).

To our knowledge, this is the first study to compare the health and fitness measures across four prevalent traditional and modern sports among Chinese adults who had been performing these sports over a prolonged period of time. For the first time, we included a relatively large sample

size for multiple comparisons between traditional and modern sports, especially concerning the potential health impact of diabolo – a newly popular traditional sport for which there is little supporting evidence in the literature. Although the nature of this study was cross-sectional and we cannot rule out the possibility of reverse or bi-directional causality, the participants had been actively involved in one of the four sports for at least nine years, allowing for comparison of health and fitness outcomes among individuals with long-term participation in these different sports. However, several limitations should be considered. First, our sample was delimited to middle-aged and older Chinese adults who were qualified as NSSIs (2016-2017), living in Henan Province (China) and performing one of the four sports, which may be considered a limitation to the generalizability of the findings. Second, we did not measure the habitual PA levels of participants – higher PA levels are generally associated with greater health benefits, which could confound the overall effects on health and fitness. Finally, we did not include other covariates (e.g., age, diet, smoking status, year of beginning a certain sport) due to the unbalanced sample size in each group and limited time and conditions during data collection.

In conclusion, the comparison of health and fitness measures among middle-aged and older adults with a history of long-term participation across four different sports revealed several significant differences. Participating in aerobics, TF and diabolo might yield some different effects on blood pressure, vital capacity, balance, reaction time, body fat and central adiposity; however, for other health and fitness measures (resting heart rate, BMI, muscle mass, and grip strength), individuals who prefer to choose the two traditional Chinese sports may anticipate similar long-term effects compared to those who perform modern sports like aerobics and TF. One novel finding was that diabolo, a traditional Chinese sport, might yield a favorable effect on central adiposity and vital capacity compared to some other sports (e.g., Tai Chi). The information presented in this study may contribute to prescribing individually-tailored or culturally relevant exercise programs to address specific health benefits, while also considering social and cultural factors that may promote PA adherence and exercise enjoyment.

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