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Running Head: Correlates of persistent exercise

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***Running title*: Correlates of persistent exercise**

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Abstract

This study aimed to examine personal and social environmental correlates of physical activity habit of middle-aged and older adults, using Chinese square dancing as a natural exploratory example. Participants were 385 adults aged⩾45 years (93% female), who habitually danced on squares or parks of three old districts of Guangzhou. Multinomial logistic regression was used to identify personal, social, psychological and behavioral correlates of multi-year dance. Old age, high education, sufficient leisure time and stable social environmental factors were associated with persistent dancing, whereby education (relative risk ratio (RRR)=1.64, 95%CI:1.05,2.57) and social engagement (RRR=1.66, 95%CI:1.05,2.63) showed the largest effects. Participants dancing ≤1 year were least satisfied with their social relationships than their counterparts dancing 1~5 years (RRR=0.68) or over 5 years (RRR=0.58). Physical activity promotion for older adults should adapt from culturally-appropriate group activities and leverage community social resources to encourage voluntary participation, particularly for low-educated older women.

Keywords: active aging, physical activity, social engagement

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Introduction

Physical activity (PA) is associated with physical (Lee et al., 2012) and mental health benefits (Chekroud et al., 2018), and reduced risks of all-cause mortality (Kokkinos, 2012), By leading a physically, mentally and socially active lifestyle since middle age, the process of frailty, disability and dementia may be delayed or even prevented (NICE, 2015). Nonetheless, older adults' PA levels are generally low and their sedentary time tends to increase with age (Milanović et al., 2013; Zhang, Chen, Wang, Wang, & Jiang, 2014). PA interventions targeting older adults often result in modest increases in exercise adoption, let alone high dropout rates (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011; World Health Organization, 2009).

To design age-appropriate interventions for long-term maintenance of PA among older adults, key correlates of PA participation and adherence should be identified and understood (Trost, Owen, Bauman, Sallis, & Brown, 2002). Corresponding to the socio-ecological models (Sallis, Owen, & Fisher, 2008), previous reviews indicate that PA participation is influenced by multiple factors ranging from personal, social to environmental domains (A. E. Bauman et al., 2012; Trost et al., 2002). The most consistent personal correlates of PA are age, gender, socioeconomic status (SES) and health status; whereby old age, women (A. E. Bauman et al., 2012; Trost et al., 2002), low SES (education particularly) (Gidlow, Johnston, Crone, Ellis, & James, 2006) and poor health status (A. E. Bauman et al., 2012) were inversely associated with PA. Social factors have emerged as important correlates, such that participants receiving high levels of family or friend support were more likely to be physically active (A. E. Bauman et al., 2012; Trost et al., 2002). Nevertheless, the relationship between social factors and PA has yet been fully investigated in developing countries (A. E. Bauman et al., 2012), and the strength and direction of this relationship also remains inconclusive across English and French published articles (Scarapicchia,

Amireault, Faulkner, & Sabiston, 2017). Regarding environmental factors, most studies suggest that the perceived environmental supportiveness rather than objective neighborhood characteristics was more consistent correlates of PA (A. E. Bauman et al., 2012; Van Cauwenberg et al., 2011; Wu et al., 2016). The formation of habitual PA, that is exercising regularly in a consistent manner (Laitakari, Vuori, & Oja, 1996), may further require the presence of unchanging environmental cues, for instance, a specific location, time of day (Tappe, Tarves, Oltarzewski, & Frum, 2013) and stable PA groups (Trost et al., 2002). The World Health Organization review on PA interventions concludes that successful programs for older adults was most likely to occur in a group setting of an existing social structure or meeting place (World Health Organization, 2009).

The Chinese square dancing is such a group PA performed to music in public squares, parks or plazas. Owing to its low cost and ease of participation, it is highly popular among middle-aged and retired women, estimated to have 100 million square dancers through 2015 (Fang, 2015). Square dancers meet habitually in the early morning and/or evening after dinner, and organize themselves into rank and file led by the most proficient dancer. The size of dance groups varies from less than ten to nearly 100 (Fang, 2015) dependent on the space availability and popularity of the lead dancers. Besides health benefits of PA, square dancing provides its participants an opportunity to socialize with peers of their generation, so as to keep them socially engaged and dispel loneliness, which are determinants of active aging (World Health Organization, 2002).

Using square dancing as a natural exploratory example, the current study aims to evaluate key personal characteristics, social factors, psychological and behavioral habit responding to environment cues of multi-year dance. The understanding of why middle and older aged adults, mostly women, perform square dancing in such a voluntary and routine manner may inform targeted interventions to promote PA adoption and adherence.

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Method

Participants

The present study was carried out in Guangzhou, the capital city of Guangdong province. Major squares and parks of three old districts of Guangzhou, namely Yuexiu, Haizhu and Liwan, were identified via online map (i.e. Baidu map), if they 1) rank high in terms of land area and visitor flow, and 2) sit in residential area. Using a restricted randomizing sampling approach, eight squares and parks per district were chosen. Square-dancing groups regularly practicing in these places were used as the sampling frame, from which one dancing group per square or park were randomly selected. All square dancers of the selected group, who lived in the local community and aged ≥45 years were recruited. Onsite participant recruitment of the selected dancing group, alongside local advertisements and flyers to inform the residents of our study, was conducted from 13th Nov 2017 to 15th Dec 2017. All participants read and signed the written informed consent approved by the institutional review board. Participants completed a self-reported questionnaire under researchers' supervision. All study procedures were in accordance with the guidelines of the Declaration of Helsinki and approved by the xxxx Institutional Review Board (Approval no. L2016-004).

Measures

Years of square dancing were measured by a single question of "How long have you been regularly practicing square dancing at least once per week". Years of dance were used as the study outcome and were grouped into ≤1 year, 1-5 years and >5 years, to assess the relationship between dance duration with personal and social environmental variables listed below.

Personal characteristic measures were age, gender, education and occupational status (i.e. retired or not) as indicators of SES, as well as self-rated health status and any doctor-diagnosed chronic disease as indictors of health.

Social factor measures assessed participants' close family relationships, including marital status, whether having children and living with children if any, and contact frequency with children if not live together; and social engagement, in terms of the type (i.e. visiting friends; board games, Mahjong etc.; club activities; volunteering; or educational courses) and frequency (i.e. almost daily; at least once per week; at least once per month; several times per year) of social activity they engaged in, using the same measures as the China Health, Aging, and Retirement Longitudinal Study (Zhao, Hu, Smith, Strauss, & Yang, 2012). Participants were also asked to evaluate satisfaction with their personal relationships and life as a whole, following the five-point Likert-scale WHO Quality of Life instrument (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004), rating from "very satisfied" (scored 5) to "very dissatisfied" (scored 0).

Psychological and behavioral habit measures recorded participants' motivations of how they started and why they continued practicing square dancing; and behavioral questions concerning the usual dance time each day indicating time cues, the number of dancing days per week, duration per time and self-rated intensity to measure repetitive frequency. The later three questions were further combined as a single measure of dance volume, to indicate whether participants met the recommended level of exercise (World Health Organization, 2010): active dancers were these who engaging in moderate to high-intensity square dancing at least five days per week for at least 30 min each session, or no less than a total 150 min per week; whereas the others were coded as irregular or low intensity dancers. We additionally measured participants'

any PA other than square dancing, and the number of hours per day spent in sedentary behaviors, to have an overall picture about their PA profile.

Statistical Analysis

Univariate analysis was conducted to identify personal, social, psychological and behavioral habit measures associated with multiple years of square dancing, with t-tests for continuous variables, Chi-square tests for categorical and Kruskal-Wallis tests for ordinal variables. Multinomial logistic regression was then applied to evaluate the relative importance of key correlates of multiple year dancing habit, estimated by two sets of coefficients for each independent variable corresponding to the log odds of ≤1 year or >5 years relative to the most frequent 1~5 year dance duration. Variables that were statistically significantly associated with dance duration ($P<0.05$, two-sided) in the univariate analysis were included. Analyses were adjusted for the nesting of individual data within dance group via clustered sandwich standard error estimation, performed by STATA Version 14.0 (StataCorp, College Station, TX).

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Results

A total of 412 community-dwelling older adults who practiced square dancing in selected major squares or parks and agreed to participate in our study were recruited (response rate was 69%), of which 27 participants (6.5%) with missing values on key variables of interest were excluded; resulting in a final analysis sample of 385. The mean age of the study sample was 58.7 (standard deviation (SD) 8.0), the majority of whom were retired women with an education of high school. On average participants had been practicing square dancing for 5.7 years (SD 6.3), with 21.6% dancing for less than 1 year, 45.2% for 1 to 5 years, and 33.2% for more than 5 years (of whom 30% were over 10 years, n=38).

Table 1 shows univariate association between personal characteristics and social factors with dance duration. Participants who had longer years of square dancing tend to be older (P<0.001), retired (P<0.001) and better educated (P=0.007). There was no statistically significant group differences in self-reported health status and diagnosed chronic disease Most participants were married, and these dancing over 5 years were slightly less likely to have children (93.8% vs 98.9%, P=0.02) and live with children if they had any (61.7% vs 77.9%, P=0.01), but they contacted their children more frequently if not living together (19.6% vs 10.5%, P=0.04). Participants dancing for longer years were more actively engaged in social activities, especially visiting friends (P=0.005), doing club activities (P=0.001), volunteering (P<0.001) and taking educational courses (P<0.001) on a daily or weekly basis (P<0.001). They were more satisfied with their social relationships (P=0.01) and with life as a whole (P=0.02) than their counterparts dancing no more than 5 years.

Table 2 presents psychological and behavioral habit measures responding to environment cues associated with multiple years of square dancing. Two thirds of square-dancers were self-motived and nearly a quarter of them were encouraged by their friends, being comparable across dance duration groups (P>0.05). Fitness (96.4%), making friends (33.8%), entertainment (33.3%) and fulfilling personal interest (32.6%) were the most chosen motivations of continuing square dancing, with participants dancing over 5 years tended to focus more on social (P=0.01) and entertaining benefits (P=0.03) of square dancing. Evening after dinner was the most selected time for square dancing while these dancing over 5 years also reported dancing in the early morning (P=0.04) or morning (P=0.003). Participants of all dance duration groups had similar dance patterns, namely 5~6 days per week for an average 87.7 minutes (SD 30) every time, but these dancing over 5 years were most likely to achieve moderate to high exercise intensity (P=0.02). As

indicated by the dance volume, 61.5% participants in the ≤1-year dance group danced irregularly or with low intensity, while the corresponding proportion was less than half among these of the >5-year dance group (P=0.04). Sedentary times were similar between groups with an average of 1.6 hours (SD 1.7), and over one third of square dancers of each dance duration group also participated in other types of physical activities in additional to dancing.

Figure 1 illustrates statistically-significant correlates of long year of dancing estimated by the multinomial logistic regression adjusted for all variables included in the model. In reference to participants in 1-≤5-year dance group, these who were older, had higher education, did not live with children, actively engaged in social activities (i.e. volunteering, taking educational courses) had higher odds of being in the > 5-year dance group, whereas these who were not retired, danced irregularly or with low intensity, and were less socially engaged had higher odds of being in ≤1-year dance group. Participants who danced ≤1 year were least satisfied with their social relationships compared to their counterparts dancing 1~5 years (relative risk ratio (RRR)=0.68, 95% CI [0.51,0.91]) or these over 5 years (RRR=0.5895% CI [0.39,0.85]. Education (RRR=1.64, 95%CI [1.05,2.57]) and social engagement (RRR=1.66, 95%CI [1.05,2.63] showed the largest effect among all correlates included in the multivariate-adjusted associations with multiple years of dancing.

Discussion

This study investigated personal and social environmental characteristics of a group of middle- to older-aged adults who danced on squares or parks on a regular basis, and found that old age, high education level, sufficient leisure time (i.e. retired and not living with children), stable social environmental factors (i.e. time of day, location, frequent engagement in group activities

and satisfactions with social relationships) were key factors associated with multiple years of square dancing.

Regarding personal characteristics, in our sample dominated by female adults ≥45 years, a positive association between old age and multiple years of dancing was found, contrary to previous finding that younger age was associated with being persistently active among adults aged ≥50 years (L. Smith, Gardner, Fisher, & Hamer, 2015). This disparity may be caused by different age structure of the study samples, and the nature of dance duration that increases as a function of time. Yet, our findings demonstrate the distinction between biological aging and physical decline (McNally et al., 2017), and indicate that physical activity of a moderate intensity and not requiring high functional fitness is likely to be maintained for long period of time among older adults. We also found positive associations between educational attainment and retirement with multiple years of square dancing in agreement with the literature (Barnett, van Sluijs, & Ogilvie, 2012; A. Bauman et al., 2011; Chad et al., 2005). Our study further revealed that most of these square dancers only had an education degree lower than high school. Besides reflecting the general poor education level of the generation born around 1950s (Huang & Zhou, 2013), this finding may be due to the grassroot feature of square dancing. Initiated by amateur community dwellers, square dancing is featured by its low cost and easy participation, thus reducing access barriers to better engage older adults of low SES.

Our study provides additional insights into the persistence of regular physical activity by examining social environmental factors for engaging in square dancing. We found participants' initial reasons to start and motivations for continuing square dancing tend to associate with its social and entertaining functions; and the longer years they have been practicing square dancing, the more socially engaged and more satisfied they were, consistent with ecological models (Sallis

et al., 2008) and Bandura's Social Cognitive Theory (Bandura, 1987). These findings are also consistent with extant studies of White (Carlson et al., 2012; Fisher, Li, Michael, & Cleveland, 2004), African American (Mendes De Leon et al., 2009; Sweeney, Wilson, & Lee Van Horn, 2017) and East Asian (Kim & Kosma, 2013; Oka & Shibata, 2012) older adults, highlighting the essential role of supportive social environment and interpersonal interactions in initiating and maintaining physical activity across ethnicity (G. L. Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017). On the other hand, the identified negative association between living with children and dance duration may suggest Chinese older adults prioritize family obligations, such as taking care of their grandchildren (Ko & Hank, 2014) over their own leisure activities. Focusing on square dancing, a group physical activity entailing frequent social interactions with a wide social network other than family members, our study contributes to the literature by providing direct evidence on the importance of social relationships with friends for physical activity maintenance (Scarapicchia et al., 2017; G. L. Smith et al., 2017) in a developing country context (A. E. Bauman et al., 2012). As such, physical activity promotion should leverage community social resources to encourage peer support and positive social interactions for voluntary physical activity and social engagement within the neighborhood.

Several limitations of our study should be noted. First, given the special characteristics of square dancing (e.g. female dominated and culture-specific physical activity), the generalizability of the present findings to other types of group physical activity and beyond the Chinese collectivist culture remains unclear. Nevertheless, a recent review of 1.2 million USA adults found that group exercises owing to its prosocial feature were associated with the lowest mental health burden over other forms of physical activities (Chekroud et al., 2018). Consistent findings on social interactions and physical activity across different ethnic groups also guarantee future investigation in

mobilizing community social recourses in various cultural context. Second, the current study focused on key correlates of multi-year dancing habit and limited the study population to these practicing square dancing. Our study sample thus may be biased by healthy participants highly motivated for physical activity and social engagement. Comparative cohort studies matching with inactive counterparts are needed to fully understand why some people are physically active while other not, as well as factors associated with withdrawal over time. Third, our study only used self-reported measures, whereas clinical examination may give more objective evaluation on participants' health status. Finally, the cross-sectional design of the present study prevents us from drawing any causal relationship or examining changes in social environmental factors and physical activity levels as participants age. Longitudinal follow-up will provide valuable information on how these associations evolve with age.

In conclusion, physical activity interventions to increase exercise initiation and adherence among older adults should reduce barriers by addressing its acceptability and accessibility, especially for female older adults of low SES who were at the greatest risk of being physically inactive. Our study examined the Chinese square dancing as a natural exploratory example, and identified old age, high education levels, adequate leisure time, stable social group and environmental cuing as key correlates of multi-year dancing habits. These personal and social environmental correlates identified for persistent dancing provide significant insights into how to design physical activity programs for low educated female older adults, which may benefit by adapting from culturally-appropriate grassroot group activities, underscoring health education and mobilizing supportive social network of the local community.

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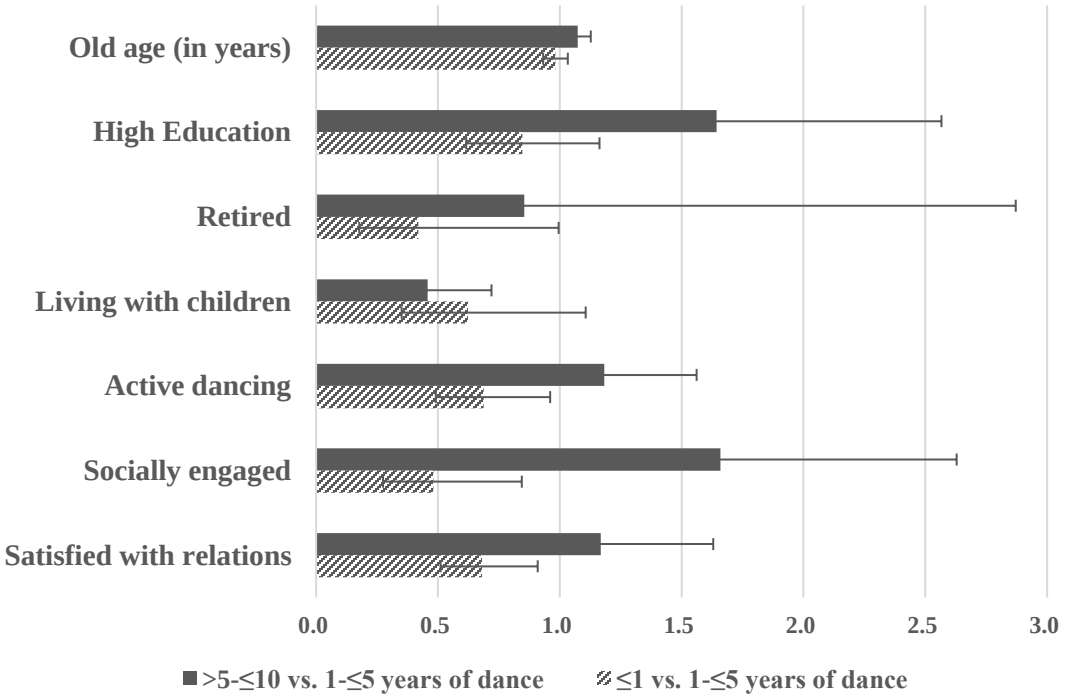

Figure 1. Relative risk ratios for correlates of long dance duration estimated by multinomial logistic regression, with the 1-≤5-year dance duration group set as the reference group.

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Table 1. Univariate association between personal characteristics and social factors with years of dance.

Variables	Total n=385		Years of dance (Years) ≤1 n=83 (21.6%)		>1~≤5 n=174 (45.2%)		>5 n=128 (33.2%)		p-value for group difference
Mean Age (SD)	58.7	(8.0)	55.9	(7.0)	58.0	(8.2)	61.6	(7.5)	<0.001
Female %	93.0		91.6		93.1		93.8		0.83
Education status %									0.007
Elementary school & below	21.2		30.1		21.3		14.4		
Middle school	36.6		38.6		39.6		30.6		
High school & above	42.2		31.3		39.0		55.0		
Retired %	80.3		60.2		83.9		88.3		<0.001
Self-reported good health %	66.0		73.5		64.9		62.5		0.44
Diagnosed chronic disease %	33.5		28.9		32.2		38.3		0.33
Married %	92.7		95.2		93.7		89.8		0.36
Have children %	97.1		98.8		98.9		93.8		0.02
Live with children [a] %	70.3		67.1		77.9		61.7		0.01
Social activity [b]									
Visiting friends	55.3		39.8		58.1		61.7		0.005
Board games, Mahjong etc.	22.9		20.5		21.8		25.8		0.61
Club activities	20.3		6.0		21.8		27.3		0.001
Volunteering	12.2		6.0		6.9		19.5		<0.001
Educational courses	12.2		6.0		6.9		23.4		<0.001
Frequency of social activity									<0.001
Almost daily	33.3		21.7		37.9		34.4		
At least once per week	26.8		16.9		25.9		34.4		
At least once per month	16.1		14.5		15.5		18.0		
Several times per year	23.9		47.0		20.7		13.3		
Satisfaction with social relationships %									0.01
Very satisfied	38.2		27.7		37.9		45.3		
Satisfied	48.8		47.0		52.3		45.3		
Neither satisfied nor dissatisfied	12.2		22.9		9.2		9.4		
Dissatisfied	0.5		1.2		0.6		0.0		
Very dissatisfied	0.3		1.2		0.0		0.0		
Satisfaction with life as a whole [c]%									0.02
Very satisfied	37.4		26.5		35.1		47.7		
Satisfied	53.8		59.0		57.5		45.3		
Neither satisfied nor dissatisfied	8.1		13.3		6.3		7.0		

Variables	**Total n=385**	**Years of dance (Years)**			p-value for group difference
		≤1 n=83 (21.6%)	**>1~≤5** n=174 (45.2%)	**>5** n=128 (33.2%)	
Dissatisfied	0.8	1.2	1.2	0.0	

[a.] Among participants having children n=374;

[b] Among participants not living with children n=111.

[c] No one was very dissatisfied when considering satisfaction for life as a whole.

Table 2. Univariate analysis between psychological and behaviour habit with years of dance.

Variables	**Total** n=385	**Years of dance (Years)**			p-value for group difference
		≤1 n=83	**>1~≤5** n=174	**>5** n=128	
Motivation of starting square dancing %					0.15
Self-motived	67.7	73.0	67.4	64.8	
Friends-encouraged	24.3	25.7	20.5	27.3	
Family-encouraged	2.1	1.4	4.6	0.0	
Community-organized	3.9	0.0	5.3	4.7	
Company-organized	0.6	0.0	0.8	0.8	
Others	1.5	0.0	1.5	2.3	
Motivation of continuing square dancing [a] %					
Fitness	96.4	92.8	98.3	96.1	0.09
Making friends	33.8	27.7	29.3	43.8	0.01
Losing weight	11.7	12.1	13.2	9.4	0.59
Entertainment	33.3	27.7	29.3	42.2	0.03
Personal interest	32.6	20.3	33.3	39.1	0.02
Others	1.6	3.6	0.6	1.6	0.18
Dance time of day [a] %					
Early-morning	21.3	12.1	21.8	26.6	0.04
Morning	21.6	8.4	23.6	27.3	0.003
Evening	63.9	80.7	58.1	60.9	0.001
Frequency #days/week (SD)	5.7 (1.7)	5.7 (1.8)	5.7 (1.8)	5.6 (1.6)	0.55
Duration #min/time (SD)	87.7(30.0)	82.7(26.3)	89.6(33.0)	88.7(27.9)	0.16
Intensity %					0.02
Light	45.7	57.8	43.1	41.4	
Moderate	40.0	27.7	46.0	39.8	
Hard	14.3	14.5	10.9	18.8	
Volume [b]					0.04
Irregular or low intensity	49.6	61.5	47.7	44.5	
Active dancing	50.4	38.5	52.3	55.5	
Sedentary time, hour (SD)	1.6 (1.7)	1.5 (2.1)	1.7(1.6)	1.7(1.5)	0.49
Other physical activity [c] %	36.1	33.3	33.3	40.6	0.40

[a] Participants could choose multiple answers.

[b] Active dancing group was these danced ≥5 days/week for 30 min/time or achieved a total 150 min/week of moderate exercise, the others were grouped as irregular or low intensity group.

[C] Percentage of participants who conducted physical activity in additional to square dancing.