Life Science Journal

Websites:
http://www.lifesciencesite.com
http://www.sciencepub.net

Emails:
editor@sciencepub.net
sciencepub@gmail.com

MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Using Questionnaire of EQ-5D to Assess the Impact of Line Dancing Exercise on Older Adults with Dysmobility Syndrome

*Xiaoli Liao

Henan Huaxia Esti Biotech Co., Ltd.
Room 1308, Building 5, R&D, No. 11 Changchun Road, Zhengzhou High tech Zone
*First and Corresponding author E-mail：liao1037392291@126.com

ABSTRACT: Geriatric dysmobility syndrome (DMS) is a public health concern for the elderly. However, a comprehensive self-rated assessment of exercise in the elderly with DMS has rarely been validated. Using a simple effective self-rated dichotomous EQ-5D questionnaire, we aimed to assess the impact of line dancing exercise on older adults with DMS. Via line dancing training exercise, we did survey to investigate the customer value on loyalty included 199 older adults living in an elderly community with a mean age of 68±2 years, of whom 76 diagnosed with DMS. According to their wishes, we arranged the participants either into line dancing group (IG) or control group (CG) via the estimation of self-rated EQ-5D questionnaire, Cox and Logistic regression models to assess the impact of line dancing exercise on older adults with DMS. We calculated odds ratio, predicted probability, hazard ratio (HR), and recovery rate (RR) in comparison between the IG and CG. In crosstabulation analysis, the hazard ratio for DMS in IG compared to CG was (HR, 0.836, 95% C.I., 0.687-1.018, p<0.005). Within 24 weeks, the hazard ratio changed significantly (HR, 5.365, 95% C.I., 3.478-8.275, p<0.005). Through a binary logistic regression model, DMS was considered as the outcome and self-rated dichotomous EQ-5D total score as a predictor, at baseline, the odds ratio was (OR, 1.269, 95% C.I., 0.707-2.278, P>0.05). After 24 weeks of follow-up, in IG, exercise impact described by (OR, 0.05, 95% C.I., 0.6-0.079, P<0.001). The Cox regression model predicted that the elderly with an EQ-5D total score of 7 had a 99% rehabilitation from DMS after 18 weeks and a 45% in 6 weeks. Relapse rate was low to 0.1% in these short-term 24 weeks study and neglected. This study revealed the impact of the line dancing exercise on the older adults with dysmobility syndrome in 24 weeks via the simple effective self-rated EQ-5D analysis as well as Cox and Logistic regression models.
[Xiaoli Liao. **Using Questionnaire of EQ-5D to Assess the Impact of Line Dancing Exercise on Older Adults with Dysmobility Syndrome**. *Life Sci J* 2024;21(5):16-25]. ISSN 1097-8135 (print); ISSN 2372-613X (online). http://www.lifesciencesite.com. 02. doi:10.7537/marslsj210524.02.

Keywords: Dysmobility syndrome, Line dancing, Logistic regression model

1. Introduction

In 2013, Binkley et al. defined dysmobility syndrome (DMS) as the cooccurrence of any three of the six symptomatic factors, including (1) osteoporosis, (2) falls in the previous year, (3) increased body fat, (4) decreased muscle mass, (5) slow gait speed, and (6) low grip strength **[1, 2]**. However, factors of (4), (5), and (6) are symptoms of sarcopenia **[3-5].** Furthermore, frail falls and body fat are causative factors in metabolic syndrome (MetS) **[6-8]**. Thus, DMS appears to be a comorbidity of sarcopenia, osteoporosis and metabolic syndrome **[1, 9, 10].** Meanwhile, there is no effective drug treatment for DMS **[11-13]**. So far, exercise is still likely the best therapy for reversing frailty **[14-17]**. For the elderly at high risk of frailty with the outcome of dysmobility syndrome, we assessed the impact of a line dance in older adults living in an elderly dwelling community**[16, 18, 19].** For the subjects with DMS any item (dimension) self-rated more than 2 points in the EQ-5D-5L, line dance should not be suitable for them **[20].** In this study, we had to eliminate subjects who were unable to perform line dancing training. Among our 300 customers living in elderly community, we eliminated 101 participants self-rated any of the dimension more than 2 points in the EQ-5D-5L questionnaire. Nevertheless, using a simple and effective self-rated dichotomous EQ-5D questionnaire helped us to gain a more comprehensive understanding of the rehabilitation rate of the line dancing exercise on the elderly with dysmobility syndrome.

2. Methods

2.1 Sample Participants

In China, new large-scale senior residential care facility has been developed quickly **[21]**. We selected our customers who used the electrical health measuring and alarming system lived in senior dwelling care facility in the suburb area of Zhengzhou City, in 2019. All the applicants were non-disabled facility-dwelling adults, age 65 years and older, with physical examination reported no difficulty for walking, ability to climb stairs, and ability to follow directions.

Criteria for screening included the use of an ambulatory assistive device, Parkinson's disease, stroke, use of portable oxygen, internal cardiac defibrillator, myocardial infarction within a year, malignant tumors, acute illness, the severity of psychiatric symptoms via the criterion of DSM-5, failure to pass the evaluation of AD8 (CDR or CASI) and Morse, and having syndromes of high risk in the emergency or fatal crisis. With screening out 66 from 300 customers who did not meet the screening conditions, 20 subjects who withdrew the courses due to illness, 10 subjects who missed training-classes more than 3 times, and 2 subjects who died in car accidents, in the study period from 29 August to 5 March 2020, the baseline sample finally kept 199 older adults in this study, 114 in the line dancing intervention group (IG), and 85 in the usual care control group (CG) at their discretion.

The participants submitted the informed consent form, certificate of negative PCR test of COVID-19 per week, self-rated dichotomized EQ-5D instrument at the 0^{th} (at beginning), 6^{th}, 12^{th}, 18^{th}, and 24^{th} week, and the following up physical examinations at the week of 12^{th} and 24th approved by professional clinicians and psychiatrists. We presented the basic demographics of the study cohort in **Table 1** and the health status of the sample participants in chronological order in **Table 2**. Because of the surge of the virus COVID-19, we carefully scheduled the line dancing classes for the elderly. We opened 30 classes for the customers at different time segments in a day, seven days a week, with no more than six people at each time. All must strictly adhere to the social distancing of 1.5 meters and no more than the 50-minute requirement of not wearing the mask in class at dancing.

2.2 Measures

We used dual-energy X-ray absorptiometry (DXA) to determine muscle quantity **[22]** and the diagnostic indicator of bone mass density(BMD) T score **[23]**. If T score of -2.5 or lower, it indicated subjects with osteoporosis **[24]**. The stages of sarcopenia were classified according to the European Working Group on Sarcopenia in older people as presarcopenia, sarcopenia, and severe sarcopenia **[25]**. In this study, we referred to the elderly with ASMI cutoff values <7.0 kg/m^2 in males and <5.00 kg/m^2 in females as the criterion of presarcopenia **[26, 27]**. Meanwhile, according to the AWGS 2019, we using gait speed assessment and handgrip strength **[3, 22]** as the criteria for the diagnosis of sarcopenia based on grip strength (Men: <30 kg, Women: <20 kg), gait speed (6-m course/Men: Height ≤ 173 cm ≥ 7s, Height > 173 cm ≥ 6s, Women: Height ≤ 159 cm ≥ 7s, Height > 159 cm ≥ 6s).

Blood test samples were obtained in a fasting state fo all participants. Serum albumin (Alb), alkaline phosphatase (ALP), calcium (Ca), phosphorus (P), eGFR, hemoglobin A1c (HbA1c), 25-hydroxy vitamin D (25-(OH) D), insulin-like growth factor 1 (IGF-1), Creatinine(B), AST/GOT, TRIG, ALT, LDL-C, and CRP were examined as the reference to diagnose the patient with metabolic syndrome. The National Cholesterol Education Pro-gram (NCEP) Adult Treatment Group III (ATP III) proposed the diagnostic criteria for evaluating metabolic syndrome, including waist circumference (male ≥ 90 cm, female ≥ 80 cm), triglyceride (≥ 150 mg/dl) HDL-C (Male <40 mg/dl, female <50g/dl), blood pressure (≥140/85 mmHg) and fasting blood glucose level (≥100 mg/dl) **[28, 29]**. The American Heart Association released the latest guidelines on the standard value of hypertension on November 13, 2017, redefining that blood pressure above 130/80 mmHg (systolic blood pressure 130 mmHg, diastolic blood pressure 80 mmHg) as high blood pressure **[30]**. We diagnose patients with metabolic syndrome based on any three simultaneous manifestations of the criteria defined by ATP III **[31, 32]**.

Table 1. Cohort Demographics N (%)

Status		Total		Control Group		Intervention Group	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**
Sample Participants		99(49.7)	100(50.3)	43(21.6)	42(21.1)	56(28.1)	58(29.1)
Age(years)	>71	17(8.5)	0	0	0	17(8.5)	0
	≦71	82(41.2)	100(50.3)	43(21.6)	42(21.1)	39(19.6)	58(29.1)
	Average (Mean ± SD)	69±3	67±2	68±3	67±2	69±8	67±2
BMI	≧24	8(4.0)	0	1(0.5)	0	7(3.5)	0
	<24	91(45.7)	100(50.3)	42(21.1)	42(21.1)	49(24.6)	58(29.2)
	Average (Mean ± SD)	20±3	20±4	18±5	19±4	20±4	21±4
Education	High School	23(11.6)	37(18.6)	20(10.0)	30(15.1)	3(1.5)	7(3.5)
	Associate degree	20(10.0)	8(4.0)	10(5.0)	0	10(5.0)	8(4.0)
	Undergraduate	50(25.1)	45(22.6)	10(5.0)	10(5.0)	40(20.1)	35(17.6)
	Master	4(2.0)	9(4.5)	3(1.5)	2(1.0)	1(0.5)	7(3.5)
	Doctorate	2(1.0)	1(0.5)	0	0	2(1.0)	1(0.5)
Living Status	Lives alone	50(25.1)	51(25.6)	36(18.1)	35(17.6)	14(7.0)	16(8)
	Lives with someone	49(24.6)	49(24.6)	7(3.5)	7(3.5)	42(21.1)	42(21.1)
Marital Status	Married	49(24.6)	49(24.6)	26(13.1)	26(13.1)	23(11.6)	23(11.6)
	Widower	32(16.1)	29(14.6)	15(7.5)	10(5.0)	17(8.5)	19(9.5)
	Divorced	2(1.0)	6(3.0)	0	3(1.5)	2(1.0)	3(1.5)
	Never Married	16(8.0)	16(8.0)	2(1.0)	3(1.5)	14(7.0)	13(6.5)

Table 2. Characteristics of the sample participants

Health Status		Usual Care Control Group						Line Dancing Intervention Group					
		Male			Female			Male			Female		
		Base Line	12th weeks	24th weeks	Base Line	12th weeks	24th weeks	Base Line	12th weeks	24th weeks	Base Line	12th weeks	24th weeks
Dysmobility Syndrome		26(13.1)	48(24.1)	49(24.6)	27(13.6)	44(23.6)	47(23.6)	33(16.6)	3(1.5)	3(1.5)	43(21.6)	6(3.0)	5(2.5)
Metabolic Syndrome		12(6)	15(7.5)	18(9.0)	11(5.5)	15(7.5)	18(9.0)	10(5)	3(1.5)	1(0.5)	10(5.0)	5(2.5)	3(1.5)
Sarcopenia		15(7.5)	15(7.5)	14(7.0)	18(9.0)	17(8.5)	17(8.5)	16(8.0)	1(0.5)	1(0.5)	32(16.1)	1(0.5)	1(0.5)
Hypertension	>130mmHg	13(6.5)	13(6.5)	14(7.0)	2(1.0)	5(2.5)	3(1.5)	20(10.1)	3(1.5)	13(6.5)	9(4.5)	7(3.5)	5(2.5)
	Average (Mean±SD)	121±2	132±9	132±9	125±1	122±3	123±1	129±0	122±1	126±4	125±2	124±5	124±0
High HbAlc	≧5.7	11(5.5)	13(6.5)	14(7.0)	14(7.0)	13(6.5)	20(10.1)	6(3.0)	0(0.0)	2(1.0)	7(3.5)	5(2.5)	3(1.5)
	Average (Mean±SD)	4.85±0.05	5.40±0.40	5.50±0.60	5.25±0.05	5.10±0.30	5.80±0.00	5.33±0.30	4.78±0.25	5.05±0.55	5.29±0.20	4.96±0.20	5.04±0.02
High Cholesterol	>250mg/dL	16(8.0)	14(7.0)	14(7.0)	11(5.5)	15(7.5)	15(7.5)	7(3.5)	2(1.5)	2(1.5)	15(7.5)	6(3.0)	8(4.0)
	Average (Mean±SD)	230.05±62.65	230.95±19.05	223.83±34.18	209.50±35.50	219.25±9.65	224.25±9.65	207.45±27.30	191.3±27.35	199.32±26.68	212.15±21.85	200.44±6.35	204.23±7.75
High Triglycerides	>2.2 mmol/L	12(6.0)	9(4.5)	12(6.0)	18(9.0)	18(9.0)	18(9.0)	16(8.0)	1(0.5)	1(0.5)	19(9.5)	8(4.0)	11(5.5)
	Average (Mean±SD)	0.95±1.35	0.95±1.35	0.95±1.35	2.40±0.10	2.60±0.00	2.53±0.08	1.87±0.55	1.23±0.60	1.13±0.70	2.02±0.25	1.51±1.95	1.72±0.85
Osteoporosis	T-score <-2.5 SD	26(13.1)	27(13.6)	25(12.6)	26(13.1)	25(12.6)	35(17.6)	33(16.6)	8(4.0)	7(3.5)	43(21.6)	10(5.0)	9(4.5)
Presarcopenia	ASMI≦7.0-male ASMI ≦5.0-Female ASMI	11(5.5)	17(8.5)	20(10.1)	9(4.5)	15(7.5)	17(8.5)	24(12.0)	2(1.0)	2(1.0)	12(6.0)	9(4.5)	6(3.0)
	Average (Mean±SD)	7.50±0.20	8.50±0.00	8.50±0.00	6.95±0.35	6.90±0.40	6.70±0.50	7.09±0.50	7.88±0.50	7.93±0.50	7.24±1.55	7.35±1.05	7.54±1.05

The self-rate EQ-5D-5L questionnaire was used as a disease-specific tool that comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression **[33],** each dimension has 5 levels (scores): no problems (1 point), slight problems (2 points), moderate problems (3 points), severe problems (4 points), and extreme problems (5 points), we would use it to describe the DMS. For safety and practical reasons, an older adult with DMS who has any one of the EQ-5D-5L dimension levels above 2 would not be suitable for line dance training rehabilitative intervention. Therefore, we dichotomized the EQ-5D-5L to dichotomized EQ-5D, using no problems (1 point) and any slight-problems (2 points) two levels to present the level of the dimension in EQ-5D **[20]**. The highest score using dichotomized EQ-5D to describe the DMS is thus 10 points and the minimum score is 5 points. Totally, we have 32 states and 6 categories, including excellent healthy category with total score of 5 points (5P), good healthy category with total score of 6 points (6P), preliminary DMS category with total score of 7 points (7P), moderated DMS category with total score of 8 points (8P), severe DMS category with total score of 9 points (9P), and extremely serious DMS category with total score of 10 points (10P) to describe all possible state status of the elderly with DMS, e.g. state 12111 (6P), state 11221 (7P), … state 22221 (9P) …etc.

From the year of 2019 to 2020, using a score-based dichotomized EQ-5D approach to DMS, we performed a sequency of comprehensive physical examinations for older adults living in an elderly community in Zhengzhou city to assess the effect of line dancing rehabilitation intervention on the older adults with DMS **[18, 34-38]**. With this approach, we can assess whether therapeutic exercise of line dancing is effective **[39]** and understand the characteristics of the development of preliminary DMS in a short period (24weeks). Line dancing training appears simple and effective for the elderly **[18, 19, 40, 41]**. Although Binkley et al. proposed six symptomatic factors, including all three major geriatric syndromes of osteoporosis, sarcopenia, obesity, and a history of falls and fractures, to define the dysmobility syndrome (DMS) classification and a framework of cut points for each of the factors in 2013, the Binkley classification does not require any basic or prerequisite elements **[1].** Not only we focused on the components of DMS, including osteoporosis, sarcopenia or obesity, but also recognized the importance of comorbidity geriatric disease to improve identification of older adults at risk for disability, falls and fractures. Therefore, we described the dysmobility syndrome as osteoporosis sarcopenia 2022-ICD-10-CM-M62.84 comorbid with 2022 ICD-10-CM Diagnosis Code M81.0 and Metabolic Syndrome 2022-ICD-10-CM-88.81 **[42].**

2.3 Line Dancing Exercise

We set the location of the line dancing classes in the gym at the center of the dwelling community, where there is enough space and floor for line dance training. Because line dancing is a low-impact dance suitable for the elderly **[18]**, we proposed the training class twice a week for 24 weeks. The courses are taught by professional dance instructors and assisted by physical therapists. The line dancing referred to simple routines from the novice class and was modified by the physical therapist, including similar steps to the novice line dance, and continuously integrates the legs, trunk, weight transfer, and posture control.

2.3.1 Procedures

Beginners like dancing to a whole range of line dancing class to all genres of music, like country, Irish, Latin and pop. The dance steps were modified so all participants could learn and follow easily. Modified choreographed movements included the adjustments of speed and strength of walking forward/backward **[43]**, side to side, turns, pivots, grapevine patterns, shuffles, knee flexion, stepping and stomping. The line dancing class was taught by progressing from easy to more complex dance movements. Previously learned dances were repeated the following week. Participants learned and performed the dances at a slower tempo before performing the choreography at a moderate pace.

Modifications were documented on a participant log. The instructor and the physical therapist kept on watching participants for difficulty with the movements and introduced a similar but less challenging movement as a replacement. The class included 10 minutes of warm-up, 40 minutes of dancing with 5 minutes break time, and 10 minutes of cool-down. The warm-up session included the stretching of arms and legs as well as the waist. The line dance training program included learning new dances, practice time, and reviewing dances learned previously.

None of the participants reported heavy to maximal exertional dyspnea via the Borg rating evaluation **[44]**. The line dancing instructor gave verbal instructions and visual cues while demonstrating the movements. When teaching new steps, the instructor demonstrated facing the participants before facing the opposite direction. Participants were asked to wear supportive and comfortable shoes for the classes.

2.3.2 Adherence

In this study, we used the attendance to describe the adherence **[45]** of the line dancing intervention. Attendance should be essential to ensuring that participants receive adequate interventions, and every line dancing class in this study was monitored and recorded. We required participants to attend all line dancing training class being scheduled. Participants who absented classes more than twice would be removed from the IG. For those absented without notifying the caregiver, our staff would quickly contact them by cellular phone to let them know that they missed the class, and the absentees should determine if they solved the problem and come to class immediately. When it was impossible to attend, the line dancing coach would arrange a make-up class on the next day.

Subjects in CG, we kept on follow-up and thank them for their continued participation and supports in the research. Subjects in CG should maintain normal daily activities during the study period and did not engage in any regular exercise program. All participants must complete the daily activity log. After the 24 weeks of the study, the subjects in CG can get good compensations or participate another cohort study upon their wishes.

2.3.3 Safety Monitoring

For safety, participants should stop dancing and sit to rest for 5 min if at any time they felt lightheaded, dizzy, weak or tired, short of breath or had chest pains. A registered nurse was on site and an automatic external defibrillator (AED) was available for each dance class. The line dancing instructor and the therapeutic assistant had cell phones for immediate access to emergency services if needed during the classes. The participants must provide emergency contact information.

2.4 Statistical Analysis

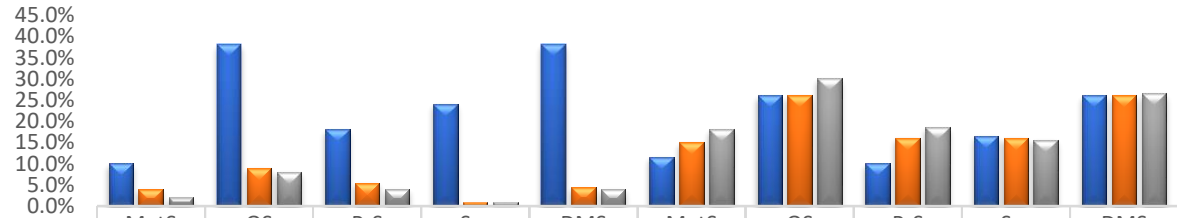
Statistically, via IBMSPSS version 25 on Cox model and logistic regression model, we calculated the hazard ratio, odds ratio, predictive probabilities of the outcome of the DMS vs. the self-rated dichotomized EQ-5D, and rehabilitation rate of the line dancing training exercise on the elderly with DMS in both IG and CG **[46]**.

3. Results

We presented the prevalence rates of dysmobility syndrome, presarcopenia, sarcopenia, osteoporosis, and metabolic syndrome in the sample population in Figure 1. Specifically, the observed drop range of the prevalence rates affected by the line dancing intervention was between 8.1% to 34.2% for the diseases surveyed in IG within 24 weeks. Meanwhile, via ROC analysis, according to the rule of max of sensitivity and lowest of specificity of the curve of "BMI vs. the dysmobility syndrome" **[47].**

We also demonstrated the best option of the threshold (cutoff value) of body mass index at (BMI, 19.64, AUC, 0.784±0.032, 95%C.I., 0.722-0.846, $p<0.001$) to identify dysmobility syndrome in Figure 2, however, the obesity was ruled out BMI<24 by WHO **[48, 49].**

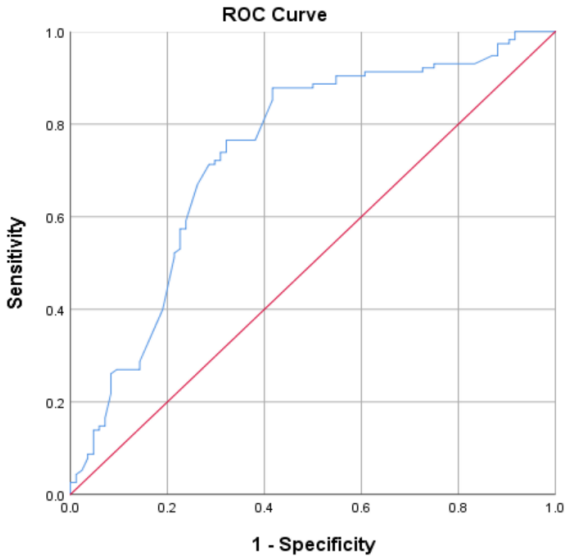
. Table 3 presented the Odds, relative risk (RR), confidence interval (C.I.), chi-square test results, and significance (Sig.) of the data analysis. After the 24th week of the intervention, the measurement results showed that the relative risk of DMS in the usual care control group was about 8 times more than that of the line dancing intervention group (IG). Table 4 presented the predictive capability of binary logistic regression predictive model for the dysmobility described as the osteoporosis comorbid with either presarcopenia, sarcopenia, or metabolic syndrome.

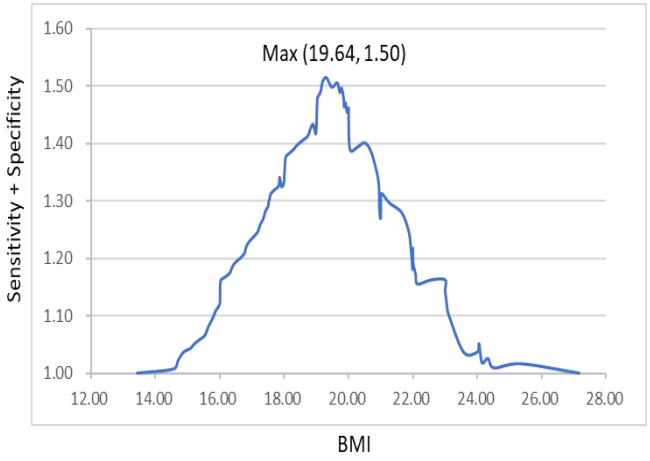


	MetS	OS	PrS	Sar	DMS	MetS	OS	PrS	Sar	DMS
	IG					CG				
Baseline	10.1%	38.2%	18.1%	24.1%	38.2%	11.6%	26.1%	10.1%	16.6%	26.1%
10 weeks	4.0%	9.0%	5.5%	1.0%	4.5%	15.1%	26.1%	16.1%	16.1%	26.1%
24 weeks	2.0%	8.0%	4.0%	1.0%	4.0%	18.1%	30.2%	18.6%	15.6%	26.6%

Abbreviations MetS: metabolic syndrome; PrS: presarcopenia; Sar: sarcopenia; Os: osteoporosis; DMS: dysmobility syndrome;
IG: line dancing intervention group; CG: usual care control group

Figure 1. Prevalence rates of the diseases on subjects in IG and CG living in an elderly dwelling care facility





(a) ROC curve (b) the optimization value (cutoff) of BMI for identifying of Dysmobility Syndrome in study cohort

Figure 2. ROC curve estimation of the BMI predicted the occurrence of dysmobility with AUC= 0.784±0.032, 95%C.I.= 0.722-0.846, p<0.001 in the cohort (b) Cutoff BMI=19.64 at highest of (sensitivity + specificity) for the subjects with dysmobility syndrome at base line in the study cohort

Table 3 Data analysis of IR and HR

Disease		OR	95% C.I.		HR	95% C.I.		χ^2	Sig.
			Lower	Upper		Lower	Upper		
Presarcopenia	Base	1.5	0.792	2.839	0.745	0.466	1.191	1.56	0.212
	12 weeks	0.177	0.083	0.379	3.902	2.089	7.288	22.534	0.000
	24 weeks	0.098	0.042	0.226	6.203	3.047	12.626	37.095	0.000
Sarcopenia	Base	1.146	0.646	2.033	0.922	0.654	1.299	0.217	0.641
	12 weeks	0.03	0.007	0.128	21.459	5.288	87.078	44.282	0.000
	24 weeks	0.031	0.007	0.135	20.788	5.116	84.474	42.425	0.000
Metabolic Syndrome	Base	0.574	0.291	1.132	1.296	0.918	1.829	2.603	0.107
	12 weeks	0.138	0.059	0.322	5.029	2.43	10.411	25.201	0.000
	24 weeks	0.049	0.017	0.147	6.918	2.715	17.63	45.748	0.000
Osteoporosis	Base	2.115	1.228	3.643	0.901	0.695	1.169	0.64	0.424
	12weeks	0.119	0.061	0.232	3.875	2.454	6.116	43.99	0.000
	24 weeks	0.068	0.034	0.138	5.029	3.129	8.084	65.974	0.000

Abbreviations C.I.: confidence interval; Sig.: significance; HR: hazard of CG compared to IG; OR: odds of IG compared to CG

Table 4 Data analysis of binary logistic regression predictive model

Model: Binary Logistic Regression Predictive Model

DMS presented as the osteoporosis comorbid with either presarcopenia or metabolic syndrome on the elderly (Only if the estimated probability was 60% or more, the subjects with DMS would be considered as occurring event)

Baseline

Outcome	Predictor	Odds Ratio	Probability*	Confidence Interval	Significance	Sensitivity	Specificity	False Positive Rate
DMS	MetS	10.3	93%	3.056-34.731	p<0.001	31.30%	95.80%	6.90%
	Presarcopenia	3.997	84%	1.821-8.773	P<0.001	36.70%	87.30%	16.10%

12-weeks after

Outcome	Predictor	Odds Ratio	Probability	Confidence Interval	Significance	Sensitivity	Specificity	False Positive Rate
DMS	MetS	25.333	0.93	3.056-34.731	p<0.001	55.90%	91.40%	36.30%
	Presarcopenia	11.313	0.72	5.192-24.653	P<0.001	51.70%	91.40%	27.90%

24-weeks after

Outcome	Predictor	Odds Ratio	Probability	Confidence Interval	Significance	Sensitivity	Specificity	False Positive Rate
DMS	MetS	16.115	0.78	6.909-37.587	p<0.001	52.50%	93.60%	22.50%
	Presarcopenia	13.538	0.73	6.183-29.645	P<0.001	55.90%	91.40%	26,7%

4. Discussion

In 2013, Binkley et al. defined DMS utilizing the measurement via questionnaire, and their purpose was to facilitate the co-treatment of the comorbidities of sarcopenia, history of falls, obesity, and osteoporosis in the elderly. Our research was mainly aimed at using line dancing training as an intervention of geriatric diseases of the elderly in care facilities, and a short-term cohort study was carried out. Therefore, for the elderly with modified DMS, we used clinical physical examination as the standard diagnosis method. Dysmobility syndrome includes the decline of bone and muscle function, increased rates of falls and fractures, and association with mortality significantly **[50]**. We modified the definition of dysmobility syndrome as a target outcome **[9]** of the osteoporosis comorbid with either metabolic syndrome, sarcopenia, or presarcopenia (early stage of sarcopenia), which matched with several reports of previous studies **[51-53]** . According to the logistic regression predictive model, a short-term cohort study found that the effect of line dancing training can inhibit the development of DMS. Comparing the predicted and observed results of MetS and presarcopenia in IG, the intervention was effective. The binary logic regression predictive model presented rational specificity and sensitivity. Due to the modified definition of DMS, it was not surprised that MetS functioned as a predictor for the outcome of DMS in the sample population. By analyzing the impact of line dancing on the target outcome of DMS, presarcopenia, and osteoporosis can be indicators of geriatric syndromes **[52-54]**. We specified the data analysis results that line dance training is a preventive intervention for dysmobility syndrome described as osteoporosis comorbid with presarcopenia, sarcopenia, or metabolic syndrome **[55, 56]** in the study cohort**.** The ROC analysis found the best cutoff values of BMI for the elderly who have significant changes in the dysmobility syndrome. We demonstrated in Figure 2 as a reference for further cohort studies.

5. Conclusions

Due to the definition, DMS described osteoporosis as comorbid with either presarcopenia, sarcopenia, or metabolic syndrome. The binary logistic regression predictive model shown in Table 4 identified the DMS as a target outcome of the predictor of metabolic syndrome and presarcopenia in the elderly. This study also found that short-term line dancing intervention can determine the cutoff of BMI for recognizing DMS in the elderly. In 1995, BMI≧24 was first recommended officially used as a criterion for identifying obesity **[48, 57].** For the elderly, the criteria of the cutoff of BMI for recognizing DMS in this study population might be used further in cohort studies. Summary of conclusion presented as follows:

What is already known?

1. DMS was defined as any three of the six symptomatic factors: (1) osteoporosis, (2) falls in the previous year, (3) increased body fat, (4) decreased muscle mass, (5) slow gait speed, and (6) low grip strength.
2. Presarcopenia was defined as the early stage of sarcopenia and a predictor of Metabolic syndrome usually **[58].**
3. The onset of dysmobility syndrome usually is hardly recognizable in the elderly

What does this study add?

4. According to the definition by Binkley et al. in 2013, we described DMS as osteoporosis comorbid with either sarcopenia or metabolic syndrome via WHO disease code
5. Presarcopenia and metabolic syndrome were observed as the predictor of DMS with high probability and sensitivity in cohort populations.
6. Based on the presence of osteoporosis comorbid either with presarcopenia, sarcopenia, or metabolic syndrome, we can identify different paths of development of the elderly with dysmobility syndrome living in the dwelling care facility.
7. Cutoffs of BMI and the components of metabolic syndrome, including blood pressure, blood sugar, triglyceride, and cholesterol can be used as the criteria recognizing DMS

Informed Consent Statement:

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the subjects to publish this paper.

Acknowledgments:

I acknowledge and thank colleagues in nursing home and hospital for the helping during the covid-19 outbreak.

Conflicts of Interest:

The author declares no conflict of interest.

References

1. Binkley, N., D. Krueger, and B. Buehring, *What's in a name revisited: should osteoporosis and sarcopenia be considered components of "dysmobility syndrome?".* Osteoporos Int, 2013. **24**(12): p. 2955-9.
2. Lee, W.J., et al., *Dysmobility Syndrome and Risk of Mortality for Community-Dwelling Middle-Aged and Older Adults: The Nexus of Aging and Body Composition.* Sci Rep, 2017. **7**(1): p. 8785.
3. Cruz-Jentoft, A.J., et al., *Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People.* Age Ageing, 2010. **39**(4): p. 412-

23.
4. Chen, L.K., et al., *Sarcopenia in Asia: consensus report of the Asian Working Group for Sarcopenia.* J Am Med Dir Assoc, 2014. **15**(2): p. 95-101.
5. Gadelha, A.B., et al., *Stages of sarcopenia and the incidence of falls in older women: A prospective study.* Arch Gerontol Geriatr, *Sarcopenia With Aging*. 2018. **79**: p. 151-157.
6. Grundy, S.M., et al., *Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference on scientific issues related to definition.* Circulation, 2004. **109**(3): p. 433-8.
7. Temkin, A.M., et al., *Increased adiposity, inflammation, metabolic disruption and dyslipidemia in adult male offspring of DOSS treated C57BL/6 dams.* Sci Rep, 2019. **9**(1): p. 1530.
9. Chen, Y.Y., et al., *Exploring the link between metabolic syndrome and risk of dysmobility syndrome in elderly population.* PLoS One, 2018. **13**(12): p. e0207608.
10. Falchetti, A. and P. Capodaglio, *What Do We Talk About When We Talk About Frailty?* Frontiers in Rehabilitation Sciences, 2021. **2**.
11. Sebastião, E. and P. Chomentowski, *Dysmobility syndrome: is exercise a key component in its prevention and treatment?* Journal of Public Health, 2017. **26**(4): p. 379-381.
12. Rubio-Ruiz, M.E., et al., *Mechanisms Underlying Metabolic Syndrome-Related Sarcopenia and Possible Therapeutic Measures.* Int J Mol Sci, 2019. **20**(3).
13. Kwak, J.Y. and K.S. Kwon, *Pharmacological Interventions for Treatment of Sarcopenia: Current Status of Drug Development for Sarcopenia.* Ann Geriatr Med Res, 2019. **23**(3): p. 98-104.
14. Chiu, C.J. and Y.Y. Cheng, *Utility of Geriatric Syndrome Indicators for Predicting Subsequent Health Care Utilization in Older Adults in Taiwan.* Int J Environ Res Public Health, 2019. **16**(3).
15. Luan, X., et al., *Exercise as a prescription for patients with various diseases.* J Sport Health Sci, 2019. **8**(5): p. 422-441.
16. Predovan, D., et al., *Effects of Dancing on Cognition in Healthy Older Adults: a Systematic Review.* J Cogn Enhanc, 2019. **3**(2): p. 161-167.
17. ANN YELMOKAS MCDERMOTT and HEATHER MERNITZ, *Exercise and Older Patients: Prescribing Guidelines.* American Family Physician, 2006. **74**(3): p. 437-444.
18. Bennett, C.G. and M.E. Hackney, *Effects of line dancing on physical function and perceived limitation in older adults with self-reported mobility limitations.* Disabil Rehabil, 2018. **40**(11): p. 1259-1265.
19. Welder, S., *The Effects of Line Dancing on Balance and Coordination in the Elderly.* UND Scholarly Commons, 2001.
20. Rabin, R. and F. de Charro, *EQ-5D: a measure of health status from the EuroQol Group.* Ann Med, 2001. **33**(5): p. 337-43.
21. Han, Y., et al., *Aging in China: perspectives on public health.* Global Health Journal, 2020. **4**(1): p. 11-17.
22. Cruz-Jentoft, A.J., et al., *Sarcopenia: revised European consensus on definition and diagnosis.* Age Ageing, 2019. **48**(1): p. 16-31.
23. Morgan, S.L. and G.L. Prater, *Quality in dual-energy X-ray absorptiometry scans.* Bone, 2017. **104**: p. 13-28.
24. CASIANO, V.E., *Diagnosis and Management of Osteoporosis.* Am Fam Physician. , 2015. **92**(4): p. 261-268.
25. Lu, Y., et al., *Assessment of Sarcopenia Among Community-Dwelling At-Risk Frail Adults Aged 65 Years and Older Who Received Multidomain Lifestyle Interventions: A Secondary Analysis of a Randomized Clinical Trial.* JAMA Netw Open, 2019. **2**(10): p. e1913346.
26. Walowski, C.O., et al., *Reference Values for Skeletal Muscle Mass - Current Concepts and Methodological Considerations.* Nutrients, 2020. **12**(3).
27. Moon, J.J., et al., *New Skeletal Muscle Mass Index in Diagnosis of Sarcopenia.* J Bone Metab, 2018. **25**(1): p. 15-21.
28. Rayssiguier, Y., et al., *Magnesium deficiency and metabolic syndrome: stress and inflammation may reflect calcium activation.* Magnes Res, 2010. **23**(2): p. 73-80.
29. Grundy, S.M., et al., *Diagnosis and Management of the Metabolic Syndrome.* Circulation, 2005. **112**(17).
30. Whelton, P.K., et al., *2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines.* Hypertension, 2018. **71**(6): p. e13-e115.
31. Kim, S.H., et al., *The effect of lowering the threshold for diagnosis of impaired fasting glucose.* Yonsei Med J, 2008. **49**(2): p. 217-23.
32. Olufadi, R. and C.D. Byrne, *Clinical and laboratory diagnosis of the metabolic syndrome.* J Clin Pathol, 2008. **61**(6): p. 697-706.
33. Herdman, M., et al., *Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L).* Qual Life Res, 2011. **20**(10): p. 1727-36.
34. Trajanoska, K., et al., *Sarcopenia and Its Clinical Correlates in the General Population: The Rotterdam Study.* J Bone Miner Res, 2018. **33**(7): p. 1209-1218.

35. Moore, J.X., N. Chaudhary, and T. Akinyemiju, *Metabolic Syndrome Prevalence by Race/Ethnicity and Sex in the United States, National Health and Nutrition Examination Survey, 1988-2012.* Prev Chronic Dis, 2017. **14**: p. E24.
36. Liu, W., et al., *Association between Metabolic Syndrome and Osteoporosis: A Systematic Review and Meta-Analysis.* Int J Endocrinol, 2021. **2021**: p. 6691487.
37. Tung-Wei Kao, et al., *Impact of adiposity on muscle function and clinical events among elders with dynapenia, presarcopenia and sarcopenia: a communitybased cross-sectional study.* Aging Clin Exp Res, 2021. **13**(5): p. 7247-7258.
38. Kechichian, A., et al., *Multimodal Interventions Including Rehabilitation Exercise for Older Adults With Chronic Musculoskeletal Pain: A Systematic Review and Meta-analyses of Randomized Controlled Trials.* J Geriatr Phys Ther, 2022. **45**(1): p. 34-49.
39. Binkley, N. and D. Krueger, *Dysmobility syndrome: a paradigm shift in fracture prevention.* Pain. Joints. Spine, 2017. **7**(1):p.1-6.
40. Gao, J., *The Sociological Research on Square Dancing in China*, in *International Conference on Arts, Design and Contemporary Education*. 2015.
41. Nadolny, A.M., et al., *A Dança Sênior® como recurso do terapeuta ocupacional com idosos: contribuições na qualidade de vida.* Cadernos Brasileiros de Terapia Ocupacional, 2020. **28**(2): p. 554-574.
42. *https://www.cdc.gov/nchs/icd/icd10cm.htm*. *https://www.cdc.gov/nchs/data/icd/Announcement-New-ICD-code-for-Post-COVID-Condition-April-2022-final.pdf.*
43. Laufer, Y., *Effect of Age on Characteristics of Forward and Backward Gait at Preferred and Accelerated Walking Speed.* Journal of Gerontology: MEDICAL SCIENCES, 2005. **60A**(5): p. 627-632.
44. Williams, N., *The Borg Rating of Perceived Exertion (RPE) scale.* Occupational Medicine, 2017. **67**(5): p. 404-405.
45. Wilhelmsen, N.C. and T. Eriksson, *Medication adherence interventions and outcomes: an overview of systematic reviews.* Eur J Hosp Pharm, 2019. **26**(4): p. 187-192.
46. Preisser, J.S., et al., *Regression models for patient-reported measures having ordered categories recorded on multiple occasions.* Community Dent Oral Epidemiol, 2011. **39**(2): p. 154-63.
47. Yi-Ting Hwang, et al., *FINDING THE OPTIMAL THRESHOLD OF A PARAMETRIC ROC CURVE UNDER A CONTINUOUS DIAGNOSTIC MEASUREMENT.* REVSTAT – Statistical Journal, 2018. **16** (1): p. 23-43.
48. *WHO Expert Committee on Physical Status : the Use and Interpretation of Anthropometry (1993 : Geneva, Switzerland) & World Health Organization. (1995). Physical status : the use of and interpretation of anthropometry , report of a WHO expert committee. World Health Organization.* *https://apps.who.int/iris/handle/10665/37003*. 1995.
49. *World Health Organization, Obesity: preventing and managing the global epidemic. Report of a WHO consultation*, in *World Health Organ Tech Rep Ser.* 2000. p. 1-253.
50. Hill, K.D., et al., *Dysmobility syndrome: current perspectives.* Clin Interv Aging, 2017. **12**: p. 145-152.
51. Drey, M., et al., *Associations between Early Markers of Parkinson's Disease and Sarcopenia.* Front Aging Neurosci, 2017. **9**: p. 53.
52. Kim, S.H., et al., *Association between sarcopenia level and metabolic syndrome.* PLoS One, 2021. **16**(3): p. e0248856.
53. Saklayen, M.G., *The Global Epidemic of the Metabolic Syndrome.* Curr Hypertens Rep, 2018. **20**(2): p. 12.
54. Xu, Y., et al., *Metabolic dysfunction associated fatty liver disease and coronavirus disease 2019: clinical relationship and current management.* Lipids Health Dis, 2021. **20**(1): p. 126.
55. Fatima, M., S.L. Brennan-Olsen, and G. Duque, *Therapeutic approaches to osteosarcopenia: insights for the clinician.* Ther Adv Musculoskelet Dis, 2019. **11**: p. 1759720X19867009.
56. Dos Santos, V.R., et al., *Practice of physical activity and dysmobility syndrome in community-dwelling older adults.* J Exerc Rehabil, 2019. **15**(2): p. 294-301.
57. Nuttall, F.Q., *Body Mass Index: Obesity, BMI, and Health: A Critical Review.* Nutr Today, 2015. **50**(3): p. 117-128.
58. Masquio, D.C., et al., *Cut-off values of waist circumference to predict metabolic syndrome in obese adolescents.* Nutr Hosp, 2015. **31**(4): p. 1540-50.