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Original Article

Preliminary investigation on the correlations among self-perceived health, dietary behavior, and sarcopenia measurements in Taiwanese adults

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Summary

Due to population aging in [removed for blind review] and in countries worldwide, promotion of active aging, reduction of sarcopenia incidence, balanced diet and sufficient protein intake, and reduction of refined sugar intake have become particularly critical among older adults. This study investigated the correlations between the perceived health, dietary behavior and sarcopenia measurements of [removed for blind review] adults. This study conducted a questionnaire survey to collect data on participants' diets for the preceding three days; on habit and frequency of exercise; and on total daily intake of protein, refined sugar, and calories. The questionnaire contained 43 items, with an average content validity ratio of 0.9. The participants were also evaluated using a sarcopenia index comprising four measurement items: body mass index, body fat percentage, grip strength, walking speed for a distance of 6 meters, and muscle mass. The results showed the higher the total daily calorie intake, the higher the daily intake of refined sugars. A low total daily intake of protein is associated with low muscle mass. The older age, lower total self-perceived health score and lower the grip performance were correlated. Older adults should be encouraged to engage in outdoor activities, a health-promoting lifestyle, social activities, and regular exercise for enhancing their positive psychological sate, preventing sarcopenia, and facilitating active aging and quality of life.

Key words: sarcopenia, self-perceived health, dietary behavior

Introduction

Increased prevalence of sarcopenia is associated with aging, and expected to continue to rise. The survey in the U.S. and some European regions showed that the prevalence of sarcopenia is between 5% and 13% of seniors aged 60 to 70, and about 11% to 50% of those over 80 (1). In Taiwan, the prevalence of sarcopenia varied from 3.9% (2.5% in women and 5.4% in men) to 7.3% (6.5% in women and 8.2% in men). A higher sarcopenia stage was significantly associated with a lower summary performance score, as well as more activities of daily living and instrumental activities of daily living difficulties (2). Due to population aging in Taiwan and in countries worldwide, promotion of active aging, reduction of sarcopenia incidence, balanced diet and sufficient protein intake, and reduction of refined sugar intake have become particularly critical among older adults. Increasing muscle mass and enhancing muscle functions are key for treating sarcopenia and frailty. Nutrition plays a crucial role in the prevention and treatment of sarcopenia; adequate nutrition and balanced diet can slow down or change the negative effects of sarcopenia on the body (3-7).

The causes of sarcopenia include neuromuscular changes resulting from aging, age-related changes

in hormone level and sensitivity, inflammatory substances (e.g., tumor necrosis factor), imbalanced nutrient intake, and loss of muscle caused by reduced activity, confinement to bed, or inactivity (5, 6). The severity of sarcopenia has three levels. Presarcopenia has developed if without loss of muscle mass, the functional impairments of slow walking speed and reduced grip strength are observed. Sarcopenia has developed if the loss of muscle mass is observed and only one of the two functional impairments is observed (5, 6, 8). Severe sarcopenia has developed if the three conditions are all observed. According to Chen's study (9), primary sarcopenia refers to sarcopenia that develops simply as a result of aging without other specific causes observed, whereas secondary sarcopenia denotes sarcopenia developing due to causes such as reduced activity (e.g., long-term confinement to bed and disabilities), diseases (e.g., severe organ failure, cancer, and endocrine diseases), and malnutrition (inadequate nutrient intake, malabsorption, and anorexia resulting from medication). Generally, the assessment and measurement of sarcopenia are conducted using muscle mass, muscle strength, and mobility (10). Being a factor affecting health-promoting behaviors, an individual's self-perceived health is determined by cognitive factors including the importance of health, self-perceived features of health, perceived self-efficacy, definition of health, and self-perceived health status (11). Self-perceived health correlates positively with one's physical activity behavior. Highly active adults often present with less muscle mass loss and lower incidence of sarcopenia. This study investigated the correlations between the perceived health, dietary behavior and sarcopenia measurements of Taiwanese adults.

Methods

Healthy adults aged 40 to 75 were eligible to participate. A total of 68 healthy adults enrolled in this study, but only 31 were successfully imaged, analyzed and used for statistical evaluation. All participants provided informed consent. Complete inspections for bone density, muscle grip, walking speed and muscle mass were made. This study conducted a questionnaire survey to collect data on participants' diets for the preceding three days; on habit and frequency of exercise; and on total daily intake of protein, refined sugar, and calories. The participants were also evaluated using a sarcopenia index comprising five measurement items: body mass index (BMI), body fat percentage, grip strength, walking speed for a distance of 6 meters, and muscle mass. This study has been reviewed and ethically approved by the institutional review board of the hospital (IRB approval no. CGH-P106048).

The measurement technique employed by the study was dual-energy x-ray absorptiometry (Hologic Horizon DXA System, Canada), which involved a dual-energy x-ray absorptiometer emitting two x-rays with different intensities to scan the body, followed by a mathematical calculation. This technique is considered an alternative method for distinguishing body fat, bone mass, and fat-free muscle and predicts muscle mass more accurately than does bioelectrical impedance analysis. The radiation exposure in dual-energy x-ray absorptiometry is low and thus is the most widely and frequently used technique in sarcopenia testing and in relevant large community studies.

The questionnaire was a structured questionnaire developed by the present researchers. Six experts and scholars in the health education domain were hired to test the questionnaire validity, and the validity was calculated using the following equation: content validity ratio (CVR) = (nE-N/2)/(N/2), where nE denotes the number of experts who considered a questionnaire item to be appropriate (namely those who rated an item with 2, 3, or 4 points), and N denotes the total number of experts. Items with a CVR ≥ 0.67 were retained in the questionnaire, and one item was removed after the validity testing. The finalized questionnaire contained 43 items, with an average CVR of 0.9.

Statistics analysis was carried out using SPSS 17.0 (SPSS Inc, Chicago, IL, USA). The Mann-Whitney U test was used to identify significant differences between sarcopenia and non-sarcopenia groups, and the logistic regression analysis was used to analyze sarcopenia-associated factors. A correlation analysis was conducted between the survey data and sarcopenia index by spearman's correlation analysis. The significant level was set at $p = 0.05$.

Results

Patient characteristics are shown in Table 1. On average, these participants were aged 55.4 ± 11.0 years, females participants accounted for 87.1% in the study. The mean of muscle mass is 5.6 ± 1.2 kg/m^2, body fat percentage is 43.0 ± 5.7%, BMI is 25.7 ± 5.3 kg/m^2, grip strength is 25.7 ±8.2 kg, and walking speed for a distance of 6 meters is 1.0 ± 0.2m/sec. The total self-perceived health scored 4.5 ± 2.6 (out of 10, with a higher score indicating that a participant perceived themselves to be healthy). 19.4% of participants reported that everything took a lot of effort to complete in daily life, 16.2% reported an activity limitation, and 45.2% reported that their current health is better than last year. The dietary behaviors scored 22.2 ± 7.3 (out of 40, with a higher score indicating that a participant perceived himself or herself to exhibit good dietary behavior). Total sugar intake was 15.9 ± 17.3 g/day, total protein intake was 73.5 ± 12.3 g/day and total calories intake was 2056.5 ± 419.3 kcal/ day (Table 1). Chronic disease is 45.2%, and the rates of alcohol consumption and smoking are low (3.2% and 0%, respectively). 16 (51.6%) participants had exercise habit; the highest frequency of exercise is 0-1 time per week 61.3%.

Comparison of the factors associated with sarcopenia between sarcopenia and non-sarcopenia were listed Table 2. The BMI, muscle mass and grip strength showed significant difference (p<0.001, p<0.001, p=0.001). Lower BMI, muscle mass and grip strength (kg) increased the risk of sarcopenia. Comparison of the total self-perceived health score, dietary behaviors score, and total sugar intake, total protein intake, total

Table 1. Basic information of participants (n = 31)

Item	Mean	Standard deviation
Total self-perceived health score (points)	4.5	2.6
Total dietary behavior score (points)	22.2	7.3
Age (years)	55.4	11.0
BMI (kg/m^2)	25.7	5.3
FAT (%)	43.0	5.7
Muscle mass (kg/m^2)	5.6	1.2
6-m walking speed (m/sec)	1.0	0.2
Grip strength (kg)	25.7	8.2
Total daily intake of refined sugar (g)	15.9	17.3
Total daily intake of protein (g)	73.5	12.3
Total daily intake of calories (kcal)	2056.5	419.3

Table 2. Comparison of demographic data between Sarcopenia and Non-Sarcopenia

	Sarcopenia	Non-Sarcopenia	
	15 (48.39%)	16 (51.61%)	
Variables	*M* ± *SD*	*M* ± *SD*	p-value [a]
Age (year)	59.53 ± 12.88	51.50 ± 7.24	0.093
BMI (kg/m^2)	22.31 ± 3.41	28.89 ± 4.84	<0.001*
Fat (%)	41.75 ± 4.45	44.11 ± 6.68	0.082
Bone Density (T-Score)	-2.20 ± 1.98	-0.51 ±1.60	0.054
Muscle mass (kg/m^2)	4.77 ± 0.63	6.44 ± 1.03	<0.001*
Walking Speed (m/sec)	0.95 ± 0.23	1.07 ± 0.20	0.281
Grip Strength (kg)	20.87 ± 6.64	30.28 ± 6.87	0.001*
Self-perceived Health Score	4.13 ± 2.53	4.88 ± 2.73	0.403
Dietary Behavior Score	22.47 ± 7.77	21.94 ± 7.15	0.751
Protein	73.65 ± 8.78	73.34 ± 15.25	0.527
Sugar	15.94 ± 14.97	16.00 ± 20.02	0.845
Calories	2079.81 ± 374.02	2034.56 ± 469.10	0.843

[a] Mann Whitney U test (2-sided)

calories intake between sarcopenia and non-sarcopenia all showed no significant difference (Table 2).

Logistic regression analysis of sarcopenia with related factors was shown in Table 3. Of these, age was positively correlated with the risk of sarcopenia. Increased BMI, muscle mass, and grip strength were negatively correlated with the risk of sarcopenia (Table 3). Only taking the females (n=27) into logistic regression, it was found that body fat is also negatively correlated with the risk of sarcopenia (Table 4).

According to the spearman rank correlation coefficient for the analysis results (Table 5), the total self-perceived health score was significantly and negatively correlated with grip strength ($p < 0.05$; r = -0.390). Age was significantly and negatively correlated with the 6-m walking speed and grip strength ($p < 0.01$ for both; r = –0.674 and –0.507, respectively). Total daily intakes of protein was significantly and positively correlated with body muscle mass ($p < 0.05$; r = 0.415). Body muscle mass was significantly and positively

Table 3. Logistic regression analysis of sarcopenia with related factors (Male & Female, n=31)

Variables	B	p-value	OR	95.0 % C.I.
Sex				
Male	1			
Female	1.173	0.335	3.231	(0.297, 35.110)
Age	0.076	0.049*	1.079	(1.000, 1.163)
BMI	-0.462	0.006*	0.630	(0.454, 0.874)
Fat	-0.076	0.256	0.926	(0.812, 1.057)
Bone Density	-0.536	0.069	0.585	(0.328, 1.043)
Muscle mass	-3.009	0.004*	0.049	(0.006, 0.375)
Walking Speed	-2.569	0.164	0.077	(0.002, 2.865)
Grip Strength	-0.300	0.014*	0.741	(0.584, 0.940)
Self-perceived Health Score	-0.114	0.428	0.892	(0.673, 1.183)
Dietary Behavior Score	0.010	0.838	1.010	(0.916, 1.114)
Sugar	0.000	0.992	1.000	(0.960, 1.043)
Protein	0.002	0.943	1.002	(0.946, 1.062)
Calories	0.000	0.760	1.000	(0.999, 1.002)

Table 4. Logistic regression analysis of sarcopenia with related factors (Female, n=27)

Variables	B	p-value	OR	95.0 % C.I.
Age	0.092	0.048*	1.096	(1.001, 1.200)
BMI	-0.958	0.027*	0.384	(0.164, 0.899)
Fat	-0.291	0.020*	0.747	(0.584, 0.956)
Muscle mass	-6.309	0.046*	0.002	(0.000, 0.905)
Walking Speed	-3.728	0.129	0.024	(0.000, 2.975)
Grip Strength	-0.277	0.022*	0.758	(0.598, 0.960)
Self-perceived Health Score	-0.191	0.264	0.826	(0.591, 1.155)
Dietary Behavior Score	0.057	0.326	1.059	(0.945, 1.187)
Sugar	-0.009	0.706	0.991	(0.948, 1.037)
Protein	0.024	0.519	1.024	(0.952, 1.102)
Calories	0.000	0.936	1.000	(0.998, 1.002)

Table 5. Nonparametric Spearman correlation results (n = 31)

	Total self–perceived health score	Total dietary behavior score	Age	BMI	FAT	Muscle mass	6–m walking speed	Grip strength	Sugar	Protein	Calories
Total self–perceived health score	–	–.234	.262	–.002	–.012	–.073	–.156	–.390*	.015	–.256	–.116
Total dietary behavior score	–.234	–	–.096	–.206	–.199	.084	.162	.142	–.299	.107	–.305
Age	.262	–.096	–	–.192	–.149	–.135	–.674**	–.507**	–.147	.047	–.030
BMI	–.002	–.206	–.192	–	.595**	.782**	–.012	.280	.060	.089	.121
FAT	–.012	–.199	–.149	.595**	–	.124	.112	–.043	.184	–.348	.015
Muscle mass	–.073	.084	–.135	.782**	.124	–	.066	.519**	–.113	.415*	.066
6–m walking speed	–.156	.162	–.674**	–.012	.112	.066	–	.364*	.002	–.138	–.097
Grip strength	–.390*	.142	–.507**	.280	–.043	.519**	.364*	–	–.152	.224	–.070
Sugar	.015	–.299	–.147	.060	.184	–.113	.002	–.152	–	–.156	.780**
Protein	–.256	.107	.047	.089	–.348	.415*	–.138	.224	–.156	–	.338
Calories	–.116	–.305	–.030	.121	.015	.066	–.097	–.070	.780**	.338	–

*Correlation achieves the 0.05 significance level (two-tailed)
**Correlation achieves the 0.01 significance level (two-tailed)

correlated with BMI and grip strength ($p < 0.01$ for both; r = 0.782 and 0.519, respectively), BMI is associated with higher body fat percentage ($p < 0.01$; r = 0.595). Accordingly, older age, low total self-perceived health score, low grip strength, inadequate protein intake, low body muscle mass were related to sarcopenia.

Discussion

The results showed the higher the total daily calorie intake, the higher the daily intake of refined sugars. It is important to consider the excessive intake of simple sugar on weight gain. In human metabolic ward studies, the sucrose or other dietary carbohydrate for fat or protein in isocaloric diets shows no effect on weight or changes in energy expenditure but will be increase body fat (12). A low total daily intake of protein is associated with low muscle mass. Inadequate protein intake during caloric restriction and increase exercise may be associated with adverse body-composition changes in postmenopausal women (13). The older age, lower total self-perceived health score and lower the grip performance were correlated. The higher the grip score, the better the 6-meter speed score. To prevent sarcopenia, one must consume adequate high-quality proteins as well as controlling the total intake of calories and refined sugar, adequate intake vitamin D and Omega-3 fish oil enrich foods (14). Older adults, despite having a higher total self-perceived health score compared with their younger counterparts, exhibited inadequate 6-m walking speed and grip strength. Accordingly, older adults should be encouraged to engage in outdoor activities, engage in a health-promoting lifestyle and social activities, and exercise regularly for enhancing their positive psychological sate, preventing sarcopenia, and facilitating active aging and quality of life (15, 16). My survey finding is the same as Rezyan's and Esmaillzadeh's study of particular dietary pattern loaded with sugars, desserts, fast foods, and hydrogenated fats, all of which were expected to raise the odds of sarcopenia considering their effect on systemic inflammation (17, 18), which is often discussed as a probable cause of sarcopenia (19, 20). Ungprasert et al.(2015) showed that a total of 448 incident cases of sarcoidosis were identified (mean age, 44.2 years; 52% women), similar to my survey (21). In contrast, dietary habit as the Western dietary pattern, characterized by a high consumption of sugar, soy, and fast foods, was not associated with sarcopenia (OR =0.51; 95% CI =0.21–1.24; P for trend < 0.13). Some study suggested that Mediterranean dietary pattern has a favorable role in prevention of sarcopenia. The Mediterranean diet is intake lots of vegetables, moderate protein intake and regular exercise. Two distressing physical challenges of growing older are a progressive increase in body fat and a corresponding decrease in lean muscle mass and quality known as sarcopenia (22). Women have more fat and lower absolute muscle mass than men, and hence may be at a greater risk of developing obesity and lower muscle strength with aging (23, 24). This finding is similar with this study, see the Table 4. The impact of obesity on women may be exaggerated owing to the greater loss of existing lower muscle stores reaching a threshold for sarcopenia in advance of that in men (24).

Adequate protein is crucial for increasing the body's muscle mass. According to Wu et al., an older adult must consume 0.8 g/kg or even 1-1.5 g/kg of protein a day to prevent muscle loss. Therefore, the present study recommended that an older adult consume 1-1.5 g/kg of protein a day to prevent sarcopenia. Leucine is one of the essential amino acids and a strong stimulating factor for the formation of muscle protein; it is effective in boosting muscle building. Vitamin D improves muscle functions and strength to a certain extent. Omega-3 fatty acids are beneficial for increasing older adults' grip strength and muscle strength (25, 26). However, the present study conducted analyses in relation to macronutrients. Future researches may further explore the relationships between micronutrients and sarcopenia measurements. Further investigation regarding the effect of dietary behavior on individuals' body fat and risks of chronic disease is required.

Nutritional care is conducive to the prevention and treatment of sarcopenia. Dietary protein intake might be beneficial to physical function for older, recommendations for daily protein intake in healthy older adults is 1.0–1.2g/kg BW. Milk is rich in vitamin D and calcium, should drink milk ≥ 1 cup/day and intake the balance diet, avoid weight loss involuntary or

malnutrition, improve the quality of life and increase physical exercise, reduce the occurrence of sarcopenia, fall down and mortality (14, 27). Further inferences based on the research results must be made with caution because the research participants were recruited through purposive sampling. All of these patients had received sarcopenia screening at a single teaching hospital in Taiwan. This sampling can produce biased results, and the research findings were thus more appropriate for exploratory research at the preliminary stage. Further research is needed to investigate potential long-term benefits of lifestyle interventions, nutritional supplements, or pharmacotherapy for sarcopenia in Asians.

Contributors

KCL contributed to this work by conception and experimental design, literature review, data collection, data analysis and interpretation, and preparation of draft manuscript. THT helped conception and experimental design, literature review, and data collection.

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