

# Quality of life in sarcopenia measured with the SarQoL® and nutritional status

Yongtaek Kim

Chungnam National University Hospital

Ki Soo Park

Gyeongsang National University

Jun-Il Yoo (✉ [furim@daum.net](mailto:furim@daum.net))

Gyeongsang National University Hospital <https://orcid.org/0000-0002-3575-4123>

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## Research

**Keywords:** Quality of life, Sarcopenia, Nutritional status, SarQoL

**Posted Date:** April 16th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-21972/v1>

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**Version of Record:** A version of this preprint was published on January 22nd, 2021. See the published version at <https://doi.org/10.1186/s12955-020-01619-2>.

# Abstract

**Background** The purpose of this study was to evaluate the relationship between nutritional status and health-related quality of life (HRQOL) after adjusting for covariates of muscle mass, calf circumference, grip strength, and the timed up and go (TUG) test for diagnosis of sarcopenia.

**Methods** A total of 324 elderly people living in rural villages who were able to move to senior and welfare centers was surveyed. To determine the nutritional status of the elderly subjects, a questionnaire-based screening tool called DETERMINE was used. Developed as a health-related quality of life tool for sarcopenia, the Sarcopenia-specific Quality of Life (SarQoL) questionnaire was used. For screening of sarcopenia, a rapid questionnaire based on self-reported information about falls, mobility, and strength known as the SARC-F questionnaire was used. Assessment of sarcopenia included skeletal muscle mass, calf circumference, grip strength, and the timed up and go (TUG) test.

**Results** As a result of evaluating the relationship between SarQoL and nutritional risk in elderly subjects, the relationship between total SarQoL score and nutritional status was statistically significant in the moderate-risk group ( $B = -5.542$ ,  $p = 0.001$ ) and in the high-risk group ( $B = -8.136$ ,  $p < 0.001$ ) in comparison to the low-risk group. Significant correlations were found in all seven domains of SarQoL, except the fear domain. The domain of leisure activity was not related to variables assessing sarcopenia, but only to nutritional risk assessment (moderate-risk group ( $B = -8.662$ ,  $p = 0.004$ ) and high-risk group ( $B = -14.943$ ,  $p < 0.001$ )).

**Conclusions** We confirmed an association between quality of life dimensions surveyed by the SarQoL questionnaire and nutritional status. Appropriate interventions are needed following brief evaluation of sarcopenia and nutritional deficiency among elderly people in communities.

## Background

Recently, sarcopenia in older people has become an important health issue. Skeletal muscle weakness due to sarcopenia has been reported to increase mortality and reduce quality of life.[1–3] For this reason, in 2016, the World Health Organization (WHO) officially identified sarcopenia as a disease of the elderly. [4, 5] In addition, sarcopenia has been classified as an important intervention target for elderly populations among medical staff and national health policies.

Specialized questionnaire tools have been developed and used to assess health-related quality of life (QOL) in older people as their muscle strength deteriorates.[1] The SarQoL questionnaire consists of seven domains and assesses quality of life in physical, mental, and social areas in the context of sarcopenia.[1, 2] This questionnaire is used to assess quality of life following intervention for sarcopenia, as well as health-related QOL in living with the condition.

Sarcopenia is caused by two representative risk factors—namely, chronic inflammation and malnutrition. [6, 7] Therefore, it is very important to assess the nutritional status of elderly people for prevention and

management of sarcopenia.

To date, most studies have evaluated improvement of nutritional disorders evaluated by muscle mass, muscle strength, physical function, and blood tests following interventions such as improved nutrition and exercise. Few studies have evaluated HRQOL. Moreover, the recently developed SarQoL questionnaire has been mostly utilized for reliability and validity verification. In other words, few studies have investigated the relationship between risk factors or components of sarcopenia (muscular strength, muscle mass, physical function, and other aspects) and HRQOL.

Therefore, the purpose of this study was to evaluate the relationship between nutritional status and HRQOL after adjusting for essential factors of muscle mass, calf circumference, grip strength, and the timed up and go (TUG) test for diagnosis of sarcopenia.

## Methods

Study participants comprised 324 individuals living in six rural villages, and research was conducted at senior and welfare centers. All participants aged 65 years who lived in villages and were able to move to senior and welfare centers were surveyed. Of a population of 351 elderly people, 341 responded that they did not suffer from cognitive impairment, cancer, stroke, or myocardial infarction. A total of 324 participants was finally included in the investigation (341 healthy respondents, excepting 17, who declined to consent to participation). All surveys were conducted on a one-on-one basis after trained researchers interviewed subjects, explained the content of the survey, and obtained written informed consent from the subjects. In addition, this study was approved by the Institutional Review Board of Gyeongsang National University (approval number: GIRB-A19-0031).

Demographic characteristics for investigation were sex, age, marital status, educational status, smoking status, and patient health questionnaire-2 (PHQ-2) survey for depression status. After the survey, the education level was divided into children under 6 years old and over 7 years old. In addition, PHQ-2 results were classified as greater or less than 3 points.[8]

## Assessment of nutritional status

To determine the nutritional status of elderly participants, a questionnaire screening tool called DETERMINE was used.[9] This self-written questionnaire consists of 10 questions, with the name, DETERMINE, referring to an alphabetic collection of the first letters (in English) of each item assessed. Thus, questionnaire items consist of **D**isease, **E**ating poorly, **T**ooth loss, **M**outh pain, **E**conomic hardship, **R**educed social contact, **M**ultiple medicines, **I**nvolutionary weight loss or gain, **N**eed for assistance in self-care, and **E**lderly [people] over 80 years old.

Weights are assigned according to importance. Nutritional risk scores were divided into 0–21 points, with 0–2 points categorizing the low-risk group, 3–5 points for the moderate-risk group, and 6 points for the high-risk group.

# SarQoL questionnaire

Developed as a health-related quality of life tool for sarcopenia, the SarQoL questionnaire consists of 55 items and 22 questions. The questionnaire calculates a total of seven domains with a total score of 0-100 points each.

Scores of survey items are distributed from 0 (worst imaginable quality of life) to 100 (best imaginable quality of life). The domains (enumerated 1–7) and items are as follows: 1) physical and mental health, assessed with eight items, such as loss of arm strength or feelings of being frail, 2) locomotion, assessed with nine items, such as limitations in walking time and difficulty in walking on uneven ground, 3) body composition, assessed with three items, such as loss of muscle mass, 4) functionality, assessed with 14 items, such as balance problems and frequency of falls, 5) activities of daily living, assessed with 15 items, such as difficulty during light physical effort, fatigue during light physical effort, and use of public transportation, 6) leisure activities, assessed with two items, such as changes in leisure activities, and 7) feelings of fear, assessed with four items, such as fear of getting hurt and fear of falling.

## SARC-F questionnaire to assess sarcopenia

This questionnaire was developed for screening sarcopenia in the elderly. Question items consist of five categories of strength, assistance required for walking, rising from a chair, climbing stairs, and frequency of falls. Sarcopenia is suspected in patients receiving more than four of 10 points.[10]

## Assessment of sarcopenia

In this study, assessment of sarcopenia includes skeletal muscle mass, calf circumference, grip strength, and the timed up and go (TUG) test. The skeletal muscle index (SMI) was calculated using the following bioelectrical impedance analysis (BIA) regression equation (measured by InBody 720, Biospace Co., Ltd., Seoul, Korea): skeletal muscle (kg) =  $[0.401 \times (\text{height}^2/\text{resistance}) + (3.825 \times \text{sex}) - (0.071 \times \text{age}) + 5.102]$ . Low muscle mass was classified as a height-adjusted SMI value  $< 5.7 \text{ kg/m}^2$  for women and  $< 7.0 \text{ kg/m}^2$  for men. Grip strength was measured using an analogue dynamometer (TK 5001 Grip-A, Takei, Tokyo, Japan), and dominant hand grip strength was classified as “robust” if the value was over 28 kg for men and over 18 kg for women. Calf circumference qualified participants for the sarcopenia risk group with a cut-off point less than 34 cm for men and less than 33 cm for women. To measure physical performance using the TUG test, each individual was asked to stand from a sitting position, walk 3 m, and then return to a sitting position on the same chair, during which a trained researcher measured the time (in seconds) required to perform this task. Times were divided into robust and abnormal based on a baseline of 10 seconds.[11]

## Statistical analysis

Frequency and mean scores were recorded. Logistic regression analysis was performed to determine the association between nutritional status and SARC-F. Multiple regression analysis was performed to determine the association between SarQoL and nutritional intake. Nutritional status was included in the

analysis as a dummy variable based on a baseline of good. All statistical analyses were performed after adjusting for demographic characteristics (sex, age, living alone, educational level, whether or not participants were smokers), symptoms of depression, muscle mass, calf circumference, grip strength, and TUG. Statistical program SPSS 23.0 was used, and a p-value less than 0.05 was considered statistically significant.

## **Results**

### **General characteristics of participants**

The average age of study subjects was 72.8 years, with women comprising 283 (87.3%) of total subjects. Of the elderly subject sample, 47.5% lived alone and 31.2% had depression. Skeletal muscle mass, calf circumference, grip strength, and TUG decreased in 11.1%, 43.5%, 21.9%, and 30.9% of all subjects, respectively. In terms of nutritional assessment, the low-risk group comprised 42.6%, the moderate-risk group comprised 29.3%, and the high-risk group comprised 28.1% of the sample (Table 1).

Table 1  
General characteristics of participants

Variables		N (%)
Sex	Male	41 (12.7)
	Female	283 (87.3)
Age	mean $\pm$ sd	72.8 $\pm$ 6.16
Living alone	No	170 (52.5)
	Yes	154 (47.5)
Education level	~ 6	196 (60.5)
	7	128 (39.5)
Smoking	No	314 (96.9)
	Yes	10 (3.1)
Depression	No	223 (68.8)
	Yes	101 (31.2)
SARC_F	< 4	256 (79.0)
	$\geq$ 4	68 (21.0)
SMI	Robust	288 (88.9)
	Low	36 (11.1)
Calf circumference	< 32	183 (56.5)
	$\geq$ 32	141 (43.5)
Grip strength	Robust	253 (78.1)
	Low	71 (21.9)
TUG	Robust	224 (69.1)
	Low	100 (30.9)
Determine (range: 0–21)	0–2	138 (42.6)
	3–5	95 (29.3)
	$\geq$ 6	91 (28.1)
Total		324 (100.0)

## Association between SARC-F and nutritional status

To evaluate the association between SARC-F and nutritional status, logistic regression analysis was performed. Among the physical assessment tools for evaluating sarcopenia, calf circumference (EXP (B) = 2.150, p = 0.037) and TUG (EXP (B) = 3.414, p = 0.001) showed statistically significant correlations (Table 2).

Table 2  
Relationship between SARC\_F and nutritional status

	Exp(B)	95% CI		P value
		Lower	upper	
Depression	0.890	0.439	1.805	0.747
SMI	1.218	0.470	3.156	0.685
<b>Calf circumference</b>	2.150	1.057	4.376	0.035
Grip strength	1.944	0.957	3.950	0.066
<b>TUG</b>	3.414	1.710	6.816	0.001
Determine (score: 3–5)	1.798	0.768	4.206	0.176
<b>Determine (score ≥ 6)</b>	3.703	1.580	8.682	0.003

## Relationship between SarQoL domain and nutritional status

Total score of SarQoL was significant in relationship to depression (B = -6.844, p < 0.001), SARC-F (B = -13.314, p < 0.001), grip strength (B = -3.866, p = 0.034), and TUG (B = -5.459, p = 0.001). The relationship between total score of SarQoL and nutritional status was significant in the moderate-risk group (B = -5.542, p = 0.001) and in the high-risk group (B = -8.136, p < 0.001) in comparison to the low-risk group (Fig. 1).

Relationships between physical and mental health and nutritional status were statistically significant in the moderate-risk group (B = -4.353, p = 0.033) and in the high-risk group (B = -7.013, p = 0.002) in comparison to the low-risk group. Trends were shown in locomotion (moderate-risk group (B = -6.127, p = 0.026) and high-risk group (B = -14.801, p < 0.001)), body composition (moderate-risk group (B = -4.924, p = 0.019) and high-risk group (B = -5.670, p = 0.017)), functionality (moderate-risk group (B = -5.542, p = 0.012) and high-risk group (B = -7.480, p = 0.003)), activities of daily living (moderate-risk group (B = -5.857, p = 0.002) and high-risk group (B = -5.287, p = 0.014)), and leisure activities (moderate-risk group (B = -8.662, p = 0.004) and high-risk group (B = -14.943, p < 0.001)). In particular, leisure activities were only significantly related to nutritional status. However, SARC-F was significantly related to physical and mental health (B = -11.741, p < 0.001), locomotion (B = -16.935, p < 0.001), body composition (B = -9.124, p < 0.001), functionality (B = -13.897, p < 0.001), and activities of daily living (B = -14.336, p < 0.001). Findings from TUG tests were significantly related to locomotion (B = -8.010, p = 0.001), functionality (B =

-6.869,  $p = 0.002$ ), and activities of daily living ( $B = -7.210$ ,  $p < 0.001$ ). In addition, grip strength was significantly related to activities of daily living ( $B = -5.103$ ,  $p = 0.014$ ) and feelings of fear ( $B = -7.243$ ,  $p = 0.001$ ). However, there were no SarQoL domains related to limb muscle mass or calf circumference (Fig. 2).

## Discussion

As a result of evaluating the relationships between SarQoL domains and nutritional risk questionnaire findings in elderly subjects, significant correlations were found in seven domains of SarQoL, with the exception of the fear domain. The domain of leisure activity is not shown to be related to the variables assessing sarcopenia, but only to nutritional risk assessment. Overall SarQoL score was associated with SARC-F, TUG, nutritional risk, and depression.

Malnutrition is documented in up to 50% of older adults, but rates of prevalence vary considerably based on demographics studied, health environment, and the method used to measure it. [12, 13] A recent systematic review and meta-analysis of studies using the Mini Nutritional Assessment shows that a high proportion of older adults are at risk of malnutrition, with estimates ranging from 27% (community/outpatient settings) to 50% (all other healthcare settings).[12] In the present study, the risk of malnutrition in participants was 29.3% (moderate) and 28.1% (severe). Therefore, it is estimated that more than 50% of rural-dwelling elderly in a community setting are malnourished. In particular, older people in East Asia, including Korea, eat rice and vegetables as dietary staples, which can contribute to malnutrition and protein deficiency.[14, 15] Consequently, these malnourished subjects are at increased risk of sarcopenia due to lack of protein intake.

The SARC-F, a rapid questionnaire based on self-reported information about falls, mobility, and strength, has been developed for early detection of sarcopenia.[16, 17] Previous studies have shown similar results of association of malnutrition and sarcopenia.[18,19] In the second version of the diagnostic criteria for sarcopenia, the SARC-F questionnaire first recommended screening at-risk groups for sarcopenia, followed by assessment of muscle strength and muscle mass and, finally, assessment of physical function to classify severity. [11, 17] Even after applying these guidelines, studies show that people suspected of malnutrition in communities are at increased risk of sarcopenia. In other words, proper interventions for malnourished elderly in communities can reduce sarcopenia. Although assessed by simple questions comprising tools such as DETERMINE and SARC-F, most SarQoL domains quickly reveal poor sarcopenia-related quality of life, with the exception of fear items in the SarQoL. Such assessment also helps to identify a group of early interventions for sarcopenia. Leisure activities (e.g., dining out, gardening, furniture making, fishing, elderly-specific activities, and walking) have only been shown to be significantly associated with DETERMINE. To enjoy these specified leisure activities in rural areas of Korea, the economic status of elderly subjects must be good, and these people will have good nutritional status.

In particular, questionnaires such as DETERMINE have been specially developed to identify nutritional deficiency in the elderly, and health-related quality of life is not expected to be good for people with moderate or severe risk of nutritional deficiency. For these populations, interventions must first be made, and nutritional interventions are required together with exercise.

## Limitations And Further Objectives

There are several limitations in this study. First, as a result of the cross-sectional study design, a causal relationship between nutritional status and SarQoL cannot be explained. In addition, the study subjects do not represent elderly people in the general population because only elderly people in rural areas were targeted. Lastly, further studies on factors affecting nutritional risks in rural-dwelling elderly people are needed, and intervention studies based on these results may be conducted.

## Conclusions

This study confirms an association between quality of life dimensions surveyed by the SarQoL questionnaire and nutritional status in elderly subjects. Therefore, appropriate interventions are needed following brief evaluation of sarcopenia and nutritional deficiency among elderly people in communities.

## Abbreviations

HRQOL

health-related quality of life

TUG

timed up and go

DETERMINE

Disease, Eating poorly, Tooth loss, Mouth pain, Economic hardship, Reduced social contact, Multiple medicines, Involuntary weight loss or gain, Need for assistance in self-care, and Elderly

SarQoL

Sarcopenia-specific Quality of Li

WHO

World Health Organization

## Declarations

### Acknowledgements

No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this study by any of the authors.

## **Authors' contributions**

Study concept and design: JIY, YTK, KSP

Acquisition of data: JIY, YTK, KSP

Analysis and interpretation: JIY, YTK, KSP

Study supervision: YTK, KSP

All authors have read and approved the manuscript.

## **Funding**

There is no funding source.

## **Availability of data and materials**

Not applicable

## **Ethics approval and consent to participate**

The study design and protocol were not needed approval by the institutional review board.

## **Consent for publication**

Not applicable.

## **Competing interests**

All authors declare that they have no conflict of interest. No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

## **Author details**

**Yongtaek Kim**

## Ki Soo Park

Department of Preventive Medicine, Institute of Health Sciences, College of Medicine, Gyeongsang National University, Jinju, Korea

Center for Farmer's Safety and Health, Gyeongsang National University Hospital, Jinju, Korea

## Jun Il Yoo

Department of Orthopedic surgery, Gyeongsang National University Hospital, Jinju, Korea

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## Figures

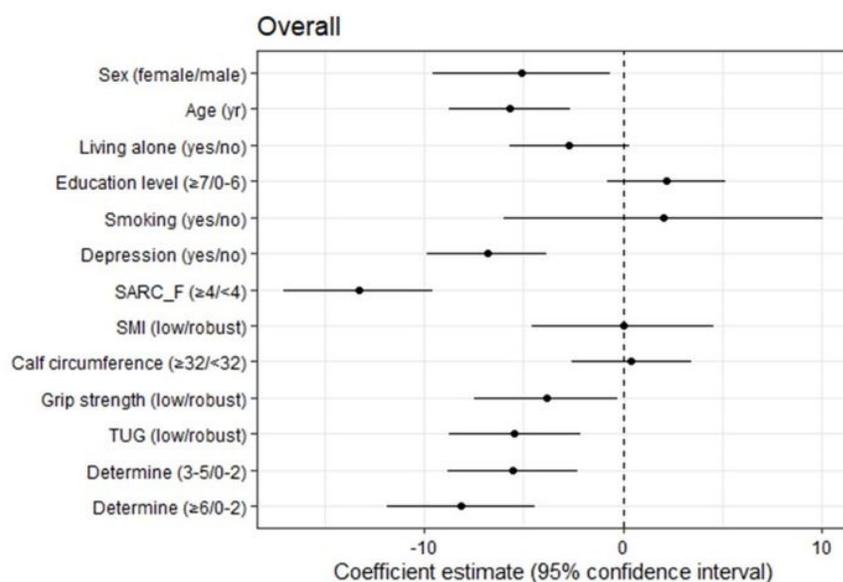
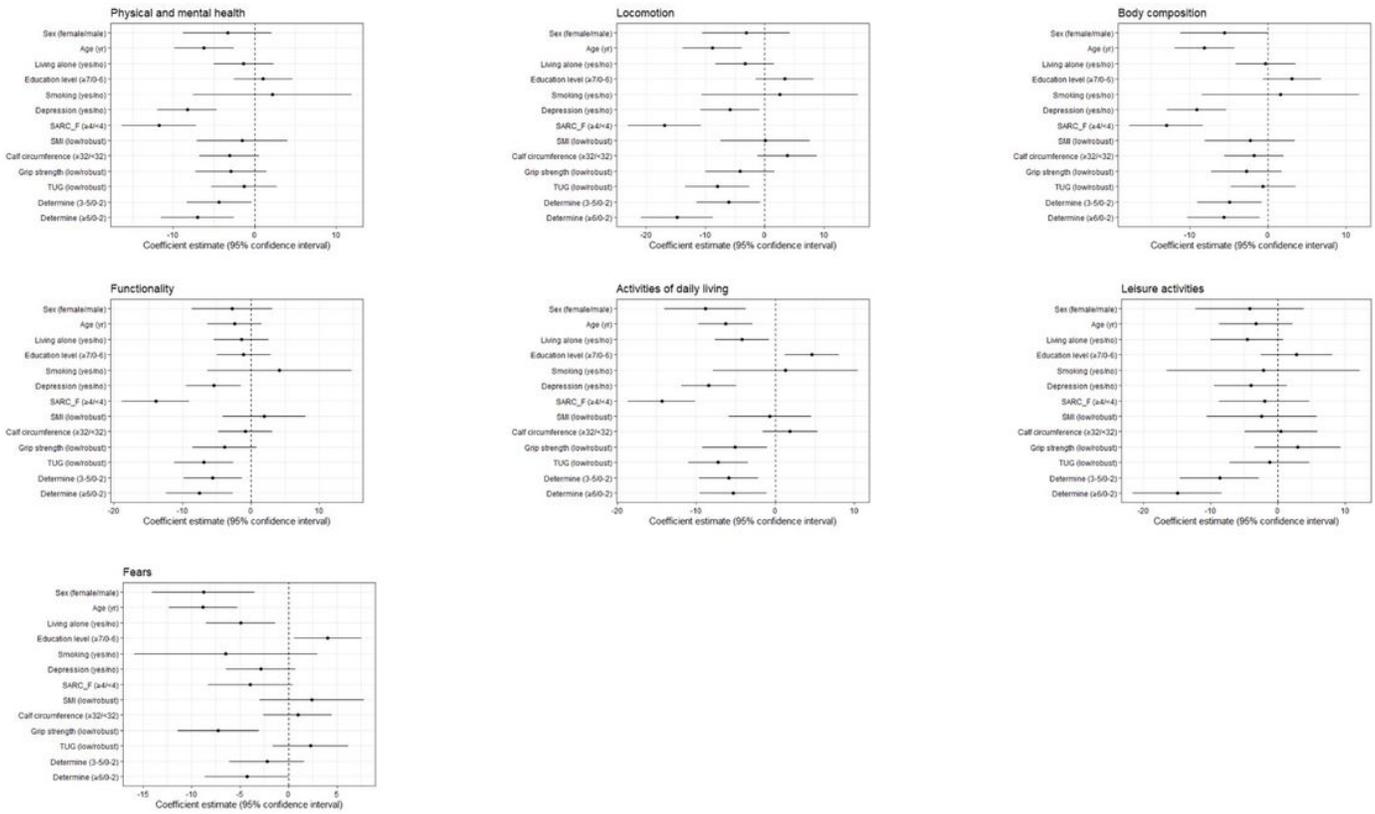


Figure 1

# The relationship between total score of SarQoL and nutritional status



**Figure 2**

Relationships between physical and mental health and nutritional status