

Sarcopenia in a Multiethnic State: A Cross-Sectional Data Analysis of Multicentre Indonesia Longitudinal Aging Study

Kuntjoro Harimurti^{1*}, Siti Setiati¹, Czeresna Heriawan Soejono¹,
IGP Suka Aryana², Sri Sunarti³, Fatichati Budiningsih⁴, Roza Mulyana⁵,
Lazuardhi Dwipa⁶, Agus Sudarso⁷, Rensa⁸, Rahmi Istanti¹,
Muhammad Khifzhon Azwar¹, Jessica Marsigit¹

¹Division of Geriatrics Department of Internal Medicine – Clinical Epidemiology and Evidence-Based Medicine Unit, Cipto Mangunkusumo Hospital – Faculty of Medicine Universitas Indonesia, Jakarta, Indonesia.

²Department of Internal Medicine, Faculty of Medicine Universitas Udayana, Bali, Indonesia.

³Department of Internal Medicine, Faculty of Medicine Universitas Brawijaya, Malang, Indonesia.

⁴Department of Internal Medicine, Faculty of Medicine Universitas Sebelas Maret, Solo, Indonesia.

⁵Department of Internal Medicine, Faculty of Medicine Universitas Andalas, Padang, Indonesia.

⁶Department of Internal Medicine, Faculty of Medicine Universitas Padjajaran, Bandung, Indonesia.

⁷Department of Internal Medicine, Faculty of Medicine Universitas Hasanuddin, Makassar, Indonesia.

⁸School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, Jakarta, Indonesia.

*** Corresponding author:**

Kuntjoro Harimurti, MD., PhD. Division of Geriatrics Department of Internal Medicine – Clinical Epidemiology and Evidence-Based Medicine Unit, Faculty of Medicine Universitas Indonesia - Cipto Mangunkusumo Hospital. Jl. Diponegoro no. 71, Jakarta 10430, Indonesia. Email: kuntjoro.harimurti@gmail.com.

ABSTRACT

Background: Previous regional studies related to sarcopenia in multiethnic Indonesia suggested inconsistent findings. We aimed to find the prevalence of sarcopenia and its associated factors among Indonesian older adults. **Methods:** In this cross-sectional analysis, we utilised the data of Indonesia Longitudinal Aging Study (INALAS) from community-dwelling outpatients in eight centres. Statistical analyses included descriptive, bivariate, and multivariate analyses. We categorised older adults into sarcopenia group based on the criteria of the SARC-F questionnaire, namely strength, assistance with walking, rising from a chair, climbing stairs, and falls questionnaire. **Results:** Among 386 older adults, 17.6% were in sarcopenia group. The prevalence of sarcopenia was found to be the lowest in Sundanese group (8.2%). Following appropriate statistical adjustment, sarcopenia was associated with female sex (OR 3.01, 95% CI 1.34-6.73), dependent functional capacity (OR 7.38, 95% CI 3.26-16.70), frailty (OR 11.82, 95% CI 5.41-25.80), and history of fall (OR 5.17 (95% CI 2.36-11.32)). Sarcopenia was not significantly associated with age 70 years and older (OR 1.67, 95% CI 0.81-3.45), Sundanese group (OR 0.44, 95% CI 0.15-1.29), and being at high risk for malnutrition or malnourished (OR 2.98, 95% CI 0.68-13.15). All centenarians had no sarcopenia nor frailty, and 80% of them were Sundanese older adults. **Conclusion:** One in five Indonesian community-dwelling older adults had sarcopenia, associated with female sex, dependent functional capacity, frailty, and history of fall. Albeit statistically nonsignificant, there may still be link between Sundanese, age 70 years and older, as well as being at high risk for malnutrition, and sarcopenia.

Keywords: sarcopenia, aging, Indonesia, community-dwelling older adults, Sundanese.

INTRODUCTION

Sarcopenia is a disease of loss of muscle mass, plus low muscle strength, and/or low physical performance. This geriatric disease is linked to higher risk of fall, disabilities, depression, institutionalisation, hospitalisation, and death.¹⁻⁴ Sarcopenia can be diagnosed by using several criteria, including those from Asian Working Group for Sarcopenia (AWGS) consensus in 2019,⁵ as well as those from European Working Group on Sarcopenia in Older People (EWGSOP2) consensus revised in 2018.⁶ Consensus from both working group suggested the importance of the SARC-F questionnaire for case finding,^{5,6} which is a simple questionnaire consisting of strength, assistance with walking, rising from a chair, climbing stairs, and falls. The questionnaire was validated in Indonesian population,⁷ and can be used for older adults with various co-morbidities.^{8,9}

Asian population appeared to have higher prevalence of sarcopenia compared with other areas in the world. Based on the latest criteria of sarcopenia, sarcopenia was found in 9.6-22.1% male Asians and in 7.7-21.8% female Asians.¹⁰ Indonesia is a country with dietary diversity among various ethnic groups,^{11,12} and different epidemiological findings related to sarcopenia among previous study locations.^{13,14}

The prevalence of sarcopenia based on AWGS 2019 consensus criteria in Surabaya was as high as 13.9% and 27.9% in male and female population, respectively.¹³ On the other hand, the prevalence was only 7.4% and 1.7% among male and female older adults in Jatinangor, West Java, respectively.¹⁴ Although previous local studies have suggested the findings related to sarcopenia,¹³⁻¹⁶ national multicentre data related to the prevalence of sarcopenia and its associated factors were lacking. Regional and ethnic differences in the prevalence of sarcopenia also warranted further data analysis.

We aimed to find the current prevalence of sarcopenia and its associated factors among Indonesian community-dwelling older adults in this cross-sectional study, based on the SARC-F questionnaire. We also provided descriptive data of Indonesian centenarians in this study. This cross-sectional data analysis is a part of the

national multicentre data analyses of Indonesia Longitudinal Aging Study (INALAS).

METHODS

Study Design and Subjects

In this cross-sectional study, we randomly selected 8 out of 17 older adults healthcare centres in Indonesia, namely Atma Jaya Hospital, Jakarta; Sanglah Hospital, Denpasar, Bali; Dr. Wahidin Sudirohusodo Hospital, Makassar, South Sulawesi; Teja Husada Hospital and Ben Mari Hospital, Malang, East Java; Dr. M. Djamil Hospital Padang, West Sumatera; Dr. Moewardi Hospital, Solo, Central Java; Hasan Sadikin Hospital, Bandung, West Java. This study was conducted in several geriatric service care centres in different islands of Indonesia from March to October 2020. The data analysis was a part of INALAS. We utilised the formula for the sample size of the estimated proportion. The minimum number of subjects to be recruited was 202 subjects.

The inclusion criterion was community-dwelling older adults aged 60 years or above in all selected hospitals who agreed to participate in the study. All subjects or their representing family member(s) signed the written informed consent form. The exclusion criteria were older adults with acute manifestations, such as illness or infections, confused mental state, cerebrovascular and/or cardiovascular events. Subjects were recruited using consecutive sampling method. We excluded subjects with incomplete data related to the SARC-F questionnaire results. Unlike the previous report of analysis of INALAS data related to frailty,¹⁷ the data from Jakarta centre were excluded due to incomplete data related to the SARC-F questionnaire results. The study population of this data analysis and that of previous data analysis were not identical. Ethical approval was obtained from the Faculty of Medicine, Universitas Indonesia.

Data Collection

We obtained secondary data from medical records and primary data from questionnaires. We defined sarcopenia as SARC-F result of 4 or higher.⁷ The SARC-F consists of five components,

namely strength, assistance in walking, rise from a chair, climb stairs, and fall. The SARC-F has been adapted and validated in Indonesian population.⁷ It has acceptable diagnostic value for sarcopenia,¹⁸ since its performance has been shown to be highly sensitive and specific for detecting sarcopenia based on the criteria from AWGS and from European Working Group for Sarcopenia in Older People (EWGSOP).⁷

The data collected for the cross-sectional study were (a) demographic data (i.e., age, sex, and ethnic groups); (b) functional status based on the Barthel Index of Activity of Daily Living (ADL) questionnaire: totally dependent (score 0–4), severely dependent (score 5–8), moderately dependent (score 9–11), slightly dependent (score 12–19), independent (score 20); (c) frailty was assessed using the FRAIL scale, consisting of fatigue, self-reported resistance (defined as the ability to climb one flight of stairs), self-reported ambulation (defined as the ability to walk one block), number of comorbid illnesses greater than 5, and weight loss of more than 5% in the previous year. One point was given if the patients answered yes to each question. If the total score was 0, the patient was categorised as robust or fit. If the total score was 1 or 2, the patient was categorised as prefrail, and if the total score was 3 or higher, the patient was categorised as frail.¹⁹ (d) nutritional status based on the Mini Nutritional Assessment Short-Form: normal nutritional status (score 12–14), at risk of malnutrition (score 8–11), malnourished (score 0–7); as well as (e) history of fall in the past 12 months. Ethnic groups were categorised into Batak, Balinese, Betawi, Chinese, Minang, Javanese, Makassarese, Sundanese, and others.

Statistical Analysis

The prevalence of sarcopenia was calculated by having the proportion of patients who were categorised as sarcopenia divided by total study subjects. For the statistical analysis, sarcopenia was divided into: (1) no sarcopenia, and (2) sarcopenia. The subjects were categorised based on their sex into male and female. Categories of age group were: (1) <70 years, and (2) ≥70 years, based on the cut-off point set by the recent epidemiological study of sarcopenia in Malaysia,²⁰ as well as that of government's profile

of Indonesian older adults.²¹ Since previous data suggested lower prevalence of sarcopenia in Jatinangor, a Sundanese region, than in other regions,^{13–15} we categorised the ethnic groups into Sundanese and non-sundanese. Categories of the functional status were divided into two categories: (1) independent, (2) dependent (for subjects with total, severe, moderate and slight dependency). Frailty status was divided into: (1) non-frail (robust and prefrail), and (2) frail. Categories according to the history of fall were: (1) no history of fall and (2) prior history of fall. Categories according to nutritional status were: (1) normal and (2) at risk of malnutrition or malnourished (for subjects with score less than 12).

We utilised SPSS Version 21 (IBM, Armonk, New York, USA) for bivariate and multivariate analyses. We used binary logistic regression to perform the bivariate analysis to assess the association between sarcopenia and the independent variables. Variables with the result of p -value < 0.25 in bivariate analysis were included in multivariate analysis. Multiple logistic regression was utilised to identify the factors associated with sarcopenia among study variables. P -value < 0.05 was considered statistically significant. We also provided descriptive data of Indonesian centenarians and the prevalence of sarcopenia according to the subject's ethnic group in this study.

RESULTS

We collected data from 386 individuals from different geriatric care centres in Indonesia, see Table 1 for subject characteristics. There was a greater proportion of older adults with independent functional status, normal nutritional status, without history of fall and without frailty. Based on SARC-F results, sarcopenia was found in 17.6% of Indonesian older adults. The prevalence of sarcopenia was 40% in Batak people, whereas it was 35.3% in people of Balinese descent, 27.2% in Betawi group, 26.8% in people of Chinese descent, 21.4% in Minang group, 14.6% in Javanese group, 8.3% in Makassarese group, and 8.2% in Sundanese group.

Bivariate analysis results suggested statistical

Table 1. Subject Characteristics (n=386)

Characteristics	Total (n=386) N (%)	Sarcopenia (n=68)	Non-Sarcopenia (n=318)
Sex			
- Male	162 (42.0)	23 (14.3)	139 (85.7)
- Female	224 (58.0)	45 (20.0)	179 (80.0)
Age			
- 60 – 69 years old	227 (58.8)	28 (12.3)	199 (87.7)
- ≥70 years old	159 (41.2)	40 (25.2)	119 (74.8)
Ethnic group			
- Javanese	137 (35.5)	20 (14.6)	117 (85.4)
- Batak	20 (1.3)	2 (4.0)	3 (6.0)
- Sundanese	61 (15.8)	(8.2)	56 (91.8)
- Chinese	71 (18.3)	19 (26.8)	52 (73.2)
- Makassarese	12 (3.1)	1 (8.3)	11 (91.7)
- Betawi	11 (2.8)	3 (27.2)	8 (72.3)
- Balinese	17 (4.4)	(35.3)	11 (64.7)
- Minang	28 (7.3)	(21.4)	22 (78.6)
- Others	44 (11.4)	6 (13.6)	38 (86.4)
Functional status			
- Independent	323 (83.7)	32 (9.9)	291 (90.1)
- Dependent	63 (16.3)	36 (57.1)	27 (42.9)
Frailty status			
- Non-frail	327 (84.7)	29 (8.9)	298 (91.1)
- Frail	59 (15.3)	39 (66.1)	20 (33.9)
Nutritional status			
- Normal	369 (95.6)	58 (15.7)	311 (84.3)
- At risk of malnutrition or malnourished	17 (4.4)	10 (58.8)	7 (41.2)
History of fall			
- No	326 (84.5)	42 (0.2)	284 (99.8)
- Yes	60 (15.5)	26 (43.3)	34 (56.7)

significance of the study variables, except female sex ($p > 0.05$), see Table 2. Based on the p-value of the results, all study variables were included in

multivariate analysis. The results of multivariate analysis showed that sarcopenia was associated with female sex (odds ratio [OR] 3.01, 95%

Table 2. Bivariate and multivariate analyses results.

Variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex		
- Male	1	1
- Female	1.52 (0.88-2.63)	3.01 (1.34-6.73)*
Age		
- 60 – 69 years old	1	1
- ≥70 years old	2.39 (1.40-4.07)*	1.67 (0.81-3.45)
Ethnic group		
- Non-sundanese	1	1
- Sundanese	0.37 (0.14-0.97)*	0.44 (0.15-1.29)
Functional status		
- Independent	1	1
- Dependent	12.13 (6.53-22.50)**	7.38 (3.26-16.70)**
Frailty status		
- Non-frail	1	1
- Frail	20.04 (10.35-38.78)**	11.82 (5.41-25.80)**
History of fall		
- No	1	1
- Yes	5.17 (2.82-9.47)**	5.17 (2.36-11.32)**
Nutritional status		
- Normal	1	1
- At risk of malnutrition or malnourished	7.66 (2.80-20.94)**	2.98 (0.68-13.15)

*p-value <0.05

**p-value <0.001

confidence interval [CI] 1.34-6.73), dependent functional capacity (OR 7.38, 95% CI 3.26-16.70), frailty (OR 11.82, 95% CI 5.41-25.80), and history of fall (OR 5.17 (95% CI 2.36-11.32). Sarcopenia was not significantly associated with age 70 years and older (OR 1.67, 95% CI 0.81-3.45), Sundanese group (OR 0.44, 95% CI 0.15-1.29), and being at high risk for malnutrition or malnourished (OR 2.98, 95% CI 0.68-13.15).

In our study populations, there were 5 centenarians. All of them were from Hasan Sadikin Hospital cohort, in Bandung. Four out of five were female. Four out of five were Sundanese older adults, whereas the other one was Javanese older adult. All centenarians had normal ADL, no sarcopenia, and not at risk for malnutrition. Four out of five were robust with no history of fall, whereas the other one were pre-frail with history of fall.

DISCUSSION

This data analysis was the second batch of statistical analyses of INALAS data, following that of frailty.¹⁷ Unlike the previous report of data analysis,¹⁷ the data from Jakarta centre in this study were excluded due to incomplete data related to the SARC-F questionnaire results. On the other hand, the data of several subjects – which were initially excluded in frailty data analysis due to incomplete data related to frailty – were included in the data analysis of this study, making the population involved in both studies not identical. In addition, this study had a larger sample size than required.

The prevalence of SARC-F-based sarcopenia was 17.6% in Indonesian older adults. The prevalence of sarcopenia was found to be the lowest in Sundanese older adults (8.2%). Albeit statistically nonsignificant, Sundanese may be a factor associated with lower risk for sarcopenia. Factors associated with higher risk for sarcopenia were female sex, dependent functional capacity, frailty, and history of fall. One out of five female older adults had sarcopenia, three out of five older adults with dependent functional status had sarcopenia, two out of three frail older adults had sarcopenia, whereas one out of two older adults with history of fall had sarcopenia. The older adults at high risk for malnutrition or

malnourished, or those aged 70 years and older, did not have statistically significant higher risk for sarcopenia. All centenarians in our study did not have sarcopenia.

Our study result suggested that nearly 1 in 5 community-dwelling older adults in Indonesia had sarcopenia. This highlights the importance of case finding in primary healthcare centres with the SARC-F, which was already validated in Indonesian population.⁷ The removal of programmes for early detection of geriatric problems in healthcare centres may lead to failure or delay in the diagnosis of the problems, including sarcopenia. Case finding, referral, and evidence-based treatment are essential, because sarcopenia is a mortality predictor in community-dwelling older adults.²²

The result of our study was within the range of the prevalence of sarcopenia in Asia.²³ The prevalence of sarcopenia does not appear to be uniform across different ethnic groups,²⁴ as also seen in our multiethnic study. The prevalence of sarcopenia was found to be the lowest in Sundanese group (8.2%). This finding supported the result of previous regional study in Jatinangor,¹⁴ a Sundanese region, in which the prevalence of sarcopenia was found to be lower than in other regional studies.^{13,15,16}

In this study, the most important factor associated with sarcopenia was frailty (OR 11.82, 95% CI 5.41-25.78). Two out of three frail Indonesian older adults in this study actually had sarcopenia. Sarcopenia and frailty have overlapping clinical consequences and features.²⁵ Sarcopenia-related components were a part of FRAIL scale screening tool, which were resistance and ambulation. Resistance was assessed by asking subjects if they had any difficulty walking up 10 steps alone without resting and without aids, whereas ambulation can be assessed by asking if the subjects had any difficulty walking several hundred yards alone and without aids. There is a downward spiral of undernutrition, frailty and sarcopenia. Decreased nutrition intake, impaired protein synthesis, acute insult(s), and immobilisation may cause sarcopenia, leading to the decline of the protein reserve of the body. Diminished capacity to meet the extra demand of protein synthesis related to

an injury or a disease will result in increased frailty. Both frailty and sarcopenia were linked with higher risk for mortality. Afterwards, frailty may cause falls, illnesses, hospitalisations, and failure to recover. The consequences may in turn cause or worsen sarcopenia.²⁶ Without intervention, this vicious cycle may repeat itself.

British Geriatrics Society (BGS), Age UK and Royal College of General Practitioners (RCGP) suggested that the gold standard for the care of people with frailty is comprehensive geriatric assessment (CGA).^{27,28} As pathologic conditions in geriatric population may be found concurrently, early detection of geriatric problems is of paramount importance, irrespective of whether the screening tools are incorporated into CGA. Once physician detects dependent functional capacity, sarcopenia, frailty, or history of fall, detection of the others are warranted.

Female sex was associated with 3 times higher risk for sarcopenia than male sex. One out of four female older adults in this study had sarcopenia. Female older adults have less muscle mass and weaker muscle strength compared to their male counterparts.²⁹ This may be due to physical inactivity that was found to be significantly higher among female than male adults.³⁰ The lack of estrogen may also reduce muscle mass in female older adults, although recent systematic review and meta-analysis of randomized controlled trials suggested that estrogen supplementation might not increase muscle mass.³¹ Interestingly, the decrease in muscle mass and muscle strength of older male adults was significantly quicker than that of older female adults.²⁹

ADL disability is increasingly recognised as a public health problem in an aging world.³² Sarcopenia was associated with dependent functional capacity in this study (OR 7.38, 95% CI 3.26-16.70). Our finding also suggested that among older adults with dependent functional status, three out of five were considered to have sarcopenia. Skeletal muscle mass is crucial for the maintenance of physical function and performing ADL.³³ As human loses a quarter of motor neurons innervating type II muscle fibers over the lifespan,³⁴ sarcopenia may be the outcome. Sarcopenia may eventually lead to

disability and adverse health outcomes.³⁵

Nearly 50% of the older adults with past history of fall were considered to have sarcopenia. History of fall was significantly associated with sarcopenia in our study (OR 5.17 (95% CI 2.36-11.32)). Our finding was in concordance with the result of systematic review and meta-analysis suggesting that sarcopenic individuals had a significantly higher risk of falls (cross sectional studies: OR 1.60, prospective studies: OR 1.89). Evidence from cross sectional and prospective studies suggested bidirectional causal relationship between falls and sarcopenia.³⁶ In the aforementioned downward spiral, falls were a part of the vicious cycle requiring detection and prompt treatment.²⁶

Although statistically nonsignificant, high risk for malnutrition may be linked with 3 times higher risk for sarcopenia. Previous systematic review and meta-analysis of observational studies suggested poor macronutrients and micronutrients intakes among Indonesian community-dwelling older adults, especially regarding the intake of protein, calcium, vitamin D and vitamin B12.³⁷

The associations between age 70 years and older, Sundanese ethnic group and sarcopenia were not statistically significant in multivariate analysis. However, the finding of both factors were significant in bivariate analysis (OR 2.39, 95% CI 1.40-4.07 for age 70 years and older; OR 0.37, 95% CI 0.14-0.97 for Sundanese group), see Table 2. It is interesting to note that age may not be the most important factor associated with sarcopenia in Indonesian cohort. The descriptive data of all centenarians in our study population suggested that all centenarians had normal ADL and no sarcopenia, which may suggest that older adults may be 100 years old without evidence of sarcopenia. Four out of five centenarians were Sundanese older adults. Since several genetic loci related to energy and lipid metabolism may play role in the pathogenesis of age-related sarcopenia,³⁸ future studies may shed light on the genetic, as well as lifestyle components of each ethnic group that may contribute to longevity, as well as lower prevalence of and lower risk for certain geriatric problems. On the other hand, the results of statistical analysis of the previous

nonsignificant factors may be affected by the sample size of our study, leading to wide 95% confidence intervals. Thus, there may still be link between Sundanese, age 70 years and older, as well as being at high risk for malnutrition, and sarcopenia.

As stated above, the prevalence of sarcopenia varied in different ethnic groups in this study. The prevalence of sarcopenia was found to be the highest in Batak, Balinese and Betawi people. Previous study in older adults suggested no difference between meat, poultry, and fish intake of Betawi and Sundanese people. Compared with Betawi cohort, Balinese older adults had higher meat and poultry intake, and Sumatran older adults had higher fish intake.¹² Sumatran may include several ethnic groups, including Batak and Minang group in this study. We hypothesised that the variety in food intake may not play the key role in causing difference in prevalence of sarcopenia between ethnic groups in Indonesia. Therefore, as mentioned before, future studies may provide data in other lifestyle and genetic components related to sarcopenia in older adults.

To the best of our knowledge, this is the first multicentre cross-sectional data in Indonesia to clarify findings of previous regional epidemiological studies with various results related to sarcopenia. Indonesia is a multiethnic archipelago and our study helped show differences in the prevalence of sarcopenia in different ethnic groups. Sarcopenic state is a potentially reversible condition and we are determined to continue INALAS data collection and analysis in the future for healthcare information, guideline, and policy. However, we acknowledge the limitations of the present study, particularly the sample size. Although the amount of subjects in our study exceeded the minimum sample size required as calculated with statistical formula, the wide confidence intervals of the study results may result from limited sample size. We also categorised the older adults into those with sarcopenia and without sarcopenia relying on history taking (SARC-F questionnaire). In resource limited settings, such as in several healthcare centres in Indonesia, diagnostic tools to assess appendicular skeletal muscle mass are unavailable. Dual-energy X-ray absorptiometry

(c) and bioelectrical impedance analysis (BIA) were not widely available. Thus, we were unable to make definitive diagnosis of sarcopenia based on the AWGS guideline released in 2019. However, the SARC-F was a validated tool in Indonesian population, with high sensitivity and specificity for detecting sarcopenia based on the criteria from AWGS and EWGSOP.⁷

CONCLUSION

In conclusion, the prevalence of sarcopenia was 17.6% in Indonesian older adults. The prevalence of sarcopenia was found to be the lowest in Sundanese older adults (8.2%). All centenarians in our study did not have sarcopenia. Factors associated with higher risk for sarcopenia were female sex, dependent functional capacity, frailty, and history of fall. One out of four female older adults had sarcopenia, three out of five older adults with dependent functional status had sarcopenia, two out of three frail older adults had sarcopenia, whereas one out of two older adults with history of fall had sarcopenia. Albeit statistically nonsignificant, there may still be link between Sundanese, age 70 years and older, as well as being at high risk for malnutrition, and sarcopenia.

COMPETING INTERESTS

The authors declare that they have no competing interests

FUNDING

We declared that this study was supported by grant from the Directorate of Research and Development, Universitas Indonesia on Internationally Indexed Publication (PUTI) (NKB-1534/UN2.RST/HKP.05.00/2020). Directorate of Research and Development, Universitas Indonesia had no role in the study design, data collection, data analysis, data interpretation and writing of the report.

AUTHORS' CONTRIBUTIONS

SSe, CS, KH, IA, SSu, FB, RM, LD, AS, RR, RI, MA, and JM contributed to development of study concept and design. SSe, CS, KH, IA, SSu, FB, RM, LD, AS, RR, and RI contributed

to acquisition of data. SSe, RI, MA, and JM contributed to analysis and interpretation of data. SSe, CS, KH, RI, MA, and JM contributed to drafting of the manuscript. All authors contributed to the article, read and approved the final manuscript.

ACKNOWLEDGMENTS

The authors wish to thank Directorate of Research and Development, Universitas Indonesia on Internationally Indexed Publication (PUTI), as well as the geriatric care centres involved in data collection.

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