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**Association of Handgrip Strength and Disability among Older People in the Central Province, Sri Lanka**

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**ABSTRACT**

Disability among older people has become a public health concern. In Sri Lanka, disability among this age group is not well understood. The objective of the study was to determine the prevalence of disability and its association with handgrip strength among community-dwelling older people in the central province, Sri Lanka. In this cross sectional study, 227 participants were included. Basic activities of Daily living (BADL) were assessed using Barthel Index. Instrumental Activities of Daily Living (IADL) was used to determine activities of daily living. Older people with more than one item of ADL and five items of IADL were considered as dependent needing assistance. Handgrip strength (HGS) was assessed using Jamar hydraulic hand dynamometer. Descriptive statistics, mean and odds ratio were analysed. Mean age of the participants was 68.73  $\pm$  7.03 years. The mean BADL value was 97.36 (SD: 8.23). The mean score for IADL score was 2.11 (SD: 2.08). The OR of HGS with BADL dependency and IADL were 0.783 (95% CI: 0.714, 0.859) and 0.897 (95% CI: 0.861, 0.935) respectively. The OR of HGS with total dependency was 0.988 (95% CI: 0.943, 1.034). HGS had a protective effect on both BADL and IADL dependency. Therefore, it can be used as a predictor for both BADL and IADL dependencies.

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**1. Introduction**

The significance of old age is increasing globally as life expectancy increases and fertility decreases [1,2]. People whose age is 60 years and over are considered as 'older people' [3]. Along with the economic development, advances in medical technology, declining fertility and increasing longevity during past few decades have resulted in people were over 60 years old in 2012, approximately 11.80% of the total population of Sri Lanka. By 2041 Sri Lanka is expected to have about 28% of its population over 60 years [4,5]. This rapid change in ageing population has an important impact on public health mainly on the economic and social costs of chronic diseases [6,7].

With rapid increase of the older population, they are likely to suffer from various health problems and irreversible decline in functional abilities. Accordingly, the number of disabled older people is also rapidly increasing [5]. The disability among this age group directly affect the economy and wellbeing of their families and communities by increased falls, decreased preventive services compliance and increased healthcare utilization and expenditures [8,9]. An immoderate level of disability leads to a rapid deterioration of quality of life and the

requirement of long-term care [10,11]. In addition to chronic diseases such as hypertension, diabetes and cerebrovascular disease, multi-morbidity among the older people is significantly associated with disability [12-14]. Magnitude of disability has become an important indicator in measuring health related outcomes [15]. Therefore, obtaining a more comprehensive picture of older people's disabilities is vital in order to promote a healthy life among this age group.

Disability is defined as a difficulty in performing BADL and IADL [16]. Limitations in basic activities of daily living (BADL) and instrumental activities of daily living (IADL) can be used to screen for disabilities in the older people [17]. All these activities are based on hand manipulation and deterioration of hand function which reduces quality and independence of life of the geriatric population [18]. Studies suggested that HGS measured by dynamometer can be used as a measure for disability among older people [19]. Hand dynamometer was used as an accurate method for assessment of HGS among older people [20]. However, limited studies determined the association between HGS, and both BADL and IADL among

older people in Sri Lanka to date. Even so, it is also of value to identify the relationship between disability and HGS instead of merely focusing on the prevalence of ADL and IADL disability. This way, HGS can be used in the assessment of disability among older people. Early detection of disability in older people may help identify those at risk of mobility limitations and apply interventions to avoid or slow down the spiral of negative outcomes.

A recent study in Sri Lanka highlighted the problems encountered by older people including functional disability [21]. The author further mentioned the need of routine assessment of the disability among older people in Sri Lanka. However, in spite of a large number of studies focusing on health promotion in Sri Lanka, research pertaining to a better understanding of disability among older people is scarce. On that account, it is important to investigate disability among older people. Hence, this study is aimed to determine the prevalence of disability and its association with HGS among community-dwelling older people in Sri Lanka.

## 2. Methodology

This was a cross-sectional study where data for this study were collected from three districts located in the Central Province of Sri Lanka (200 participants from Kandy, 66 participants from Matale and 133 participants from Nuwaraeliya). Five villages of each district were purposively selected. About one third of the total households from each village were selected and were invited to participate in our study. Sampled households were considered non responsive if the household members were not available after being approached twice. Sample size was calculated using formula of Yamane (1973) [22]:  $n = N / (1 + N(e)^2)$ . In this formula,  $n$  is size of sample,  $N$  (123,291) is population of sample, and  $e$  (5%) is probability of error. The final sample yielded 399 community-dwelling older people who met the criteria considering 20% non-response rate.

People aged 60 years and older from each household were invited to our study. The inclusion criteria for participation were elderly aged 60 years and older who consented to the study; those who were having intellectual disabilities were excluded.

Ethics clearance was obtained from the Ethics Review Committee of Faculty of Allied Health Sciences, University of Peradeniya. Written informed consent was obtained from all participants/care givers prior to the study.

### 2.1 Procedure

Three registered nurses including the principal researcher who has experience in assessing

geriatric needs discussed together prior to the commencement of the study to use the Barthel index for evaluating 10 items on the BADL, 8 item IADL to ensure that the physical assessments were consistent. The data were collected at residences of participants.

### 2.2 Research Instruments

Demographic Data Form of older people includes age, gender, education level, economic status, health status (the presence of physician-diagnosed chronic diseases include diseases like hypertension, heart attack, diabetes, epilepsy, stroke, arthritis, pneumonia, and asthma) and living arrangements.

Barthel Index /Scale of Activities of Daily Living/ADL [23] together with self-care abilities in the areas of ten daily living activities: eating, bathing, dressing, hygiene, controlling faeces, controlling urine, toileting, walking, transporting and climbing stairs used for measuring functional status. On ADLs older people/caregivers were asked the amount of difficulty, without any aid from others in performing above activities. The ability to perform these ADL tasks was assessed. The score ranged from (total disability) to 100 (no disability) points. In this study, validated Sinhala version of Barthel Index was used. Based on the previous studies, BADL disability can be defined as a Barthel Index score of 95 (which corresponds to 1 decrease in an item on the Barthel Index) or lower [24].

Instrumental Activities of Daily Living/IADL scale [25] includes eight items: Ability to use telephone, shopping, prepare foods, keep house, clean laundry, use transportation, take responsibility for own medication and handle finances. The older people were asked the limitation of the IADL activities. Each item was rated dichotomously (0 - independent, 1 - dependent). Scores were summed with higher scores indicating higher degrees of dependency. The English version of the scale was translated into Sinhala Language and the translated version was used in this study. If a participant performed all the IADL tasks, he/she was considered as independent for IADL activities. Independence for IADL is achieved with a score of 8 as used in a previous study [26].

***Older people with more than one item of ADL and five items of IADL were considered as dependent needing assistance [27].***

### Handgrip strength

After calibration of the Jamar hydraulic hand dynamometer, hand grip strength was measured in a face-to-face assessment with the participant according to the standardized protocol [20].

**2.3 Data Analysis**

IBM SPSS Statistics, Version 22 was used for statistical analysis. Descriptive statistics for categorical variables were presented in percentage and frequencies. Mean and standard deviation was used to express continuous variables. Hand grip strength of the dominant hand was reported as means and standard deviations (SD). Odds ratios (OR) with 95% confidence intervals (CI) were reported in presenting the relationship of HGS with BADL dependency, IADL dependency and total dependency. Significant level was pre-set at 0.05.

**3. Results**

**3.1 Baseline demographic characteristics**

Table 1 shows demographics of older people. Out of 227 participants, 60.8% of them were females. Mean age of the participants was 68.73 ±7.03 years. The percentage of having chronic diseases was 49.3. Most of them (96.5%) stayed with someone and the majority 67.0 % were educated up to secondary level. The mean BADL score was 95.32 (12.50) and that of IADL was 2.42 (2.72). Prevalence of both dependencies on BADL and IADL were 11.0% and 39.0% respectively. Among the participants, 17.2% were dependent for performing both BADL and IADL.

**Table 1 Demographic characteristics of older people (n=227)**

Variable	Mean (SD)	N	%
<b>Gender</b>			
Female		138	60.8
Male		89	39.2
Age (Years)	68.73 (7.03)		
<b>Having Chronic diseases</b>			
Yes		112	49.3
<b>Education</b>			
No Formal education		11	4.8
Primary		53	23.3
Secondary		152	67.0
Tertiary		11	4.8
Income (Below poverty )*		132	8.1
<b>Living arrangement</b>			
Alone		8	3.5
With another (family member/relative/friend)		219	96.5

<b>Disable condition</b>		
BADL	95.32	(12.50)
IADL	2.42	(2.72)
<b>BADL dependency</b>		
Yes	38	11.0
No	189	54.6
<b>IADL dependency</b>		
Yes	135	39.0
No	92	26.6
<b>Dependent older (&gt;1 ADL &amp; 5 IADL)</b>		
Yes	39	17.2
No	188	82.8
Handgrip strength (kg)	14.79	(7.79)

The dependence level for the basic activities of daily living is depicted in Table 2. The mean BADL value is 97.36 (SD: 8.23). The highest percentages of dependency were seen for activity of climbing stairs (9.7%) and mobility (6.2%) respectively. The least dependency was observed with transfer activity (0.9%).

**Table 2: Barthel Index assessment for BADL dependency (n=227)**

Activities	Assessment [n (%)]
<b>Feeding</b>	
Independent	221 (97.4)
Needs help	5(2.2)
Unable	1(4)
<b>Bathing</b>	
Independent	221 (97.4)
Dependent	6 (2.6)
<b>Dressing</b>	
Independent	224 (98.7)
Dependent	3 (1.3)
<b>Grooming</b>	
Independent	221 (97.4)
Needs help	5 (2.2)
Dependent	1 (4)

<b>Bowels</b>	
<i>Continent</i>	222 (97.8)
<i>Occasional accident</i>	4 (1.8)
<i>Incontinent</i>	1 (4)
<b>Bladder</b>	
<i>Continent</i>	226 (99.6)
<i>Incontinent</i>	1 (4)
<b>Toilet use</b>	
<i>Independent</i>	224 (98.7)
<i>Dependent</i>	3 (1.3)
<b>Transfers</b>	
<i>Independent</i>	22 (97.8)
<i>Minor help</i>	3 (1.3)
<i>Major help</i>	2 (0.9)
<b>Mobility</b>	
<i>Independent</i>	211 (93.0)
<i>Walks with help of one</i>	2 (0.9)
<i>Immobile</i>	14 (6.2)
<b>Stairs</b>	
<i>Independent</i>	187 (82.4)
<i>Needs help</i>	18 (7.9)
<i>Unable</i>	22 (9.7)
Total score	Mean (SD) 97.36 (8.23)

The dependence level for the IADLs is shown in Table 3. The mean score for IADL score is 2.11(SD: 2.08). The biggest relative dependency is seen in the ability to responsibility for own medications (45.8%) followed by shopping (41.9%) and food preparation (34.8%).

### 3.3 Association of HGS and BADL and IADL dependency and total dependency

The associations of HGS with BADL, IADL and total dependency is presented in Table 4. The OR of HGS with BADL dependency and IADL were 0.783 (95% CI: 0.714, 0.859) and 0.897 (95% CI: 0.861, 0.935) respectively. The OR of HGS with total dependency was 0.988 (95% CI: 0.943, 1.034).

**Table 3: Lawton and Brody Index assessment for IADL dependency (n=227)**

Activities	Assessment [n (%)]
<b>Ability to use telephone</b>	
<i>Independent</i>	161(70.9)
<i>Dependent</i>	66(29.1)
<b>Shopping</b>	
<i>Independent</i>	132(58.1)
<i>Dependent</i>	95(41.9)
<b>Food preparation</b>	
<i>Independent</i>	148(65.2)
<i>Dependent</i>	79(34.8)
<b>Housekeeping</b>	
<i>Independent</i>	203(89.4)
<i>Dependent</i>	24(10.6)
<b>Laundry</b>	
<i>Independent</i>	175(77.1)
<i>Dependent</i>	52(22.9)
<b>Mode of transportation</b>	
<i>Independent</i>	198(87.2)
<i>Dependent</i>	29(12.8)
<b>Responsibility for own medications</b>	
<i>Independent</i>	123(54.2)
<i>Dependent</i>	104(45.8)
<b>Ability to handle finances</b>	
<i>Independent</i>	186(81.9)
<i>Dependent</i>	41(18.1)
Total	Mean (SD) 2.11(2.08)

**Table 4: Association of handgrip strength, BADL dependency and IADL dependency and total dependency among older people**

Variable	Odds Ratio (95% CI)
BADL dependency	0.783 (0.714,0.859)
IADL dependency	0.897 (0.861,0.935)
Total dependency	0.988 (0.943,1.034)

#### 4. Discussion

. Majority of the study participants were females. This reflects the gender distribution of the central province in Sri Lanka. Several findings of the individual level are in agreement with those from the literature with regard to ADL disability which is similar to finding of a study done in India [28]. Yet, the comparison with studies in other countries is a bit difficult due to the use of different BADL measures. Among BADL dependency the participants were mostly dependent in climbing stairs and ambulation activities. These results are congruent with the results of a recent study conducted in Spain among older people after hip fractures [26].

Comparing BADL and IADL scores, the IADL dependency was high. Similar findings were highlighted by the recent systematic review [27]. The high level of IADL dependency corresponds to the BADL since there are actions requiring greater physical integrity and implies the necessity of higher cognitive integrity than the BADL [29]. Among IADL activities, the majority of the participants rated dependency for responsible for own medication. Taking care of older people is considered as a cultural norm in Sri Lanka and these people are specially cared when they are ill [7]. Subsequently, the majority of the participants were dependent on shopping as an activity. Due to the cultural practices among Sri Lankans, older people are accompanied by family members when they need shopping [8].

As reported in a systematic review of Hopkins et al (2017), uniformity in instruments and consistent reporting of data are essential for accurate interpretation and comparison of findings across studies [30]. However, with regard to disability considering both BADL and IADL, only one fifth of the elderly people were disabled to perform ADL and IADL activities.

The mean HGS was consistent with the recent study conducted in Sri Lanka [20]. However, the value was less than that of other countries [31]. The reason behind the dissimilarity might be the differences in body size and composition including mean height and weight [32,33]. Also, the difference between the protocols can influence the HGS results and, consequently, affect the comparability between the studies [34]. This highlights the necessity of having guidelines concerning a standardised protocol to measure HGS.

The findings of the current study confirm the predictive association between handgrip strength and both BADL and IADL disability as reported in previous studies [35,36]. This might be due to the fact that hand grip strength influences both physical and mental functioning of older people [37]. In addition, older people with reduced handgrip strength had difficulty performing tasks such as shopping for

groceries, preparing meals and performing housework [35]. However, no association was found between HGS and total disability considering both BADL and IADL. As a tradition, Sri Lankan society provides most of the social and financial support to older people as they are being considered reverence.

Several limitations of this study warrant discussion. As this study was of a cross-sectional design, causality could not be established. Secondly, recall bias may be encountered when answering questionnaires. Further, probing was used to ensure that the participants recalled information as well as they could [38]. Another limitation is the usage of the Sinhala version of IADL questionnaire that is not validated. Moreover, only the older people who were in better health conditions were able to perform HGS, which may underestimate the prevalence of low HGS. Then, the sample size considered for analysis was not large enough ( $n = 227$ ) as some participants could not perform measuring HGS. Future studies are suggested to focus on these limitations.

In addition to the above limitations, this might be the first study related to these variables among older people in Sri Lanka. Moreover, using standard protocol to measure HGS ensures the strength of the study.

#### 5. Conclusion

Disabilities of the older people were measured considering the dependencies of BADL and IADL. Based on the finding, the prevalence of BADL and IADL dependencies is considerable. Prevalence of IADL dependencies is higher than that of BADL dependencies. Further, HGS have a protective effect on both BADL and IADL dependencies. Therefore, it can be used as a predictor for both BADL and IADL dependencies.

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#### References

1. Steiner UK, Larsen LA, Christensen K. Parallel Progress in Perceived Age and Life Expectancy. *The journals of gerontology Series A, Biological sciences and medical sciences*. 2020;75(2):333-9.
2. Jia H, Lubetkin EI. Life expectancy and active life expectancy by disability status in older U.S. adults. *PLoS One*. 2020;15(9):e0238890-e.
3. Gronlund C, Christoffersen KS, Thomsen K, Masud T, Jepsen DB, Ryg J. Effect of blood-flow restriction exercise on falls and fall related risk factors in older adults 60 years or above: a

- systematic review. *J Musculoskelet Neuronal Interact.* 2020;20(4):513-25.
4. HRA M. Important Features of the Elderly Population in Sri Lanka. *Research Process.* 2014;2(2):29-38.
  5. Chen S, Zheng J, Chen C, Xing Y, Cui Y, Ding Y, et al. Unmet needs of activities of daily living among a community-based sample of disabled elderly people in Eastern China: a cross-sectional study. *BMC Geriatrics.* 2018;18(1):160.
  6. Ebrahim S, Pearce N, Smeeth L, Casas JP, Jaffar S, Piot P. Tackling non-communicable diseases in low- and middle-income countries: is the evidence from high-income countries all we need? *PLoS medicine.* 2013;10(1):e1001377.
  7. Damayanthi HDWT, Moy FM, Abdullah KL, Dharmaratne SD. Health related quality of life and its associated factors among community-dwelling older people in Sri Lanka: A cross-sectional study. *Archives of Gerontology and Geriatrics.* 2018;76:215-20.
  8. Marsh C, Agius PA, Jayakody G, Shajehan R, Abeywickrema C, Durrant K, et al. Factors associated with social participation amongst elders in rural Sri Lanka: a cross-sectional mixed methods analysis. *BMC Public Health.* 2018;18(1):636.
  9. Musich S, Wang SS, Ruiz J, Hawkins K, Wicker E. The impact of mobility limitations on health outcomes among older adults. *Geriatric Nursing.* 2018;39(2):162-9.
  10. Ramaprasad D, Rao NS, Kalyanasundaram S. Disability and quality of life among elderly persons with mental illness. *Asian journal of psychiatry.* 2015;18:31-6.
  11. Chen W, Fang Y, Mao F, Hao S, Chen J, Yuan M, et al. Assessment of Disability among the Elderly in Xiamen of China: A Representative Sample Survey of 14,292 Older Adults. *PLOS ONE.* 2015;10(6):e0131014.
  12. Uddin MJ, Alam N, Koehlmoos TP, Sarma H, Chowdhury MA, Alam DS, et al. Consequences of hypertension and chronic obstructive pulmonary disease, healthcare-seeking behaviors of patients, and responses of the health system: a population-based cross-sectional study in Bangladesh. *BMC Public Health.* 2014;14:547.
  13. Dunlop DD, Manheim LM, Sohn MW, Liu X, Chang RW. Incidence of functional limitation in older adults: the impact of gender, race, and chronic conditions. *Archives of physical medicine and rehabilitation.* 2002;83(7):964-71.
  14. Su P, Ding H, Zhang W, Duan G, Yang Y, Chen R, et al. The association of multimorbidity and disability in a community-based sample of elderly aged 80 or older in Shanghai, China. *BMC geriatrics.* 2016;16(1):178-.
  15. Gupta S. A study to assess the methodological quality of <i>in vivo</i> animal experiments published in Indian journal of pharmacology: A retrospective, cross-sectional, observational study. *Indian Journal of Public Health.* 2014;58(1):11-6.
  16. Tas U, Verhagen AP, Bierma-Zeinstra SM, Odding E, Koes BW. Prognostic factors of disability in older people: a systematic review. *The British journal of general practice : the journal of the Royal College of General Practitioners.* 2007;57(537):319-23
  17. Barberger-Gateau P, Rainville C, Letenneur L, Dartigues J-F. A hierarchical model of domains of disablement in the elderly: a longitudinal approach. *Disability and Rehabilitation.* 2000;22(7):308-17.
  18. Incel NA, Sezgin M, As I, Cimen OB, Sahin G. The geriatric hand: correlation of hand-muscle function and activity restriction in elderly. *International journal of rehabilitation research Internationale Zeitschrift fur Rehabilitationsforschung Revue internationale de recherches de readaptation.* 2009;32(3):213-8.
  19. Rashed AM, Abdel-Wahab N, Moussa EMM, Hammam N. Association of hand grip strength with disease activity, disability and quality of life in children and adolescents with Juvenile Idiopathic Arthritis. *Advances in Rheumatology.* 2018;58(1):11.
  20. Damayanthi HDWT, Moy F-M, Abdullah KL, Dharmaratne SD. Handgrip Strength and Its Associated Factors among Community-dwelling Elderly in Sri Lanka: A Cross-sectional Study. *Asian Nursing Research.* 2018;12(3):231-6.
  21. Samarasekara, DN. Care of the elderly: a multidisciplinary approach. *Journal of the Ceylon College of Physicians.* 2014;45:45-8.
  22. Anaman K, Okai J. Extent of Awareness of Birth Control Methods and Their Use by Women in a Peri-Urban Area of Accra, Ghana. *Modern Economy.* 2016;7:39-54.
  23. Mahoney FI, Barthel DW. FUNCTIONAL EVALUATION: THE BARTHEL INDEX. *Maryland state medical journal.* 1965;14:61-5.
  24. Puteh SE, Bakar, I.M., Borhanuddin, B., Latiff, K.A., Amin, R.M., & Su, R. . A Prevalence Study of the Activities of Daily Living (ADL) Dependency among the Elderly in Four Districts in Selangor,

- Malaysia. *Journal of Epidemiology and Preventive Medicine*. 2015;1(2).
25. Lawton MP, Brody EM. Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living<sup>1</sup>. *The Gerontologist*. 1969;9(3\_Part\_1):179-86.
  26. Gonzalez-Zabaleta J, Pita-Fernandez S, Seoane-Pillado T, Lopez-Calvino B, Gonzalez-Zabaleta JL. Dependence for basic and instrumental activities of daily living after hip fractures. *Arch Gerontol Geriatr*. 2015;60(1):66-70.
  27. Liu Y-H, Chang H-J, Huang C-C. The Unmet Activities of Daily Living (ADL) Needs of Dependent Elders and their Related Factors: An Approach from Both an Individual- and Area-Level Perspective. *International Journal of Gerontology*. 2012;6(3):163-8.
  28. Ohri P, Gupta SK, Upadhyai N. A Study of Daily Living Dependency Status among Elderly in an Urban Slum area of Dehradun. *INDIAN JOURNAL OF COMMUNITY HEALTH* 2014;26(4).
  29. Jefferson AL, Byerly LK, Vanderhill S, Lambe S, Wong S, Ozonoff A, et al. Characterization of activities of daily living in individuals with mild cognitive impairment. *Am J Geriatr Psychiatry*. 2008;16(5):375-83.
  30. Hopkins RO, Suchyta MR, Kamdar BB, Darowski E, Jackson JC, Needham DM. Instrumental Activities of Daily Living after Critical Illness: A Systematic Review. *Annals of the American Thoracic Society*. 2017;14(8):1332-43.
  31. Moy F, Chang E, Kee K. Predictors of Handgrip Strength among the Free Living Elderly in Rural Pahang, Malaysia. *Iran J Public Health*. 2011;40(4):44-53.
  32. Koopman JJ, van Bodegom D, van Heemst D, Westendorp RG. Handgrip strength, ageing and mortality in rural Africa. *Age and ageing*. 2015;44(3):465-70.
  33. Dodds RM, Syddall HE, Cooper R, Kuh D, Cooper C, Sayer AA. Global variation in grip strength: a systematic review and meta-analysis of normative data. *Age and ageing*. 2016;45(2):209-16.
  34. Sousa-Santos AR, Amaral TF. Differences in handgrip strength protocols to identify sarcopenia and frailty - a systematic review. *BMC geriatrics*. 2017;17(1):238-.
  35. Gopinath B, Kifley A, Liew G, Mitchell P. Handgrip strength and its association with functional independence, depressive symptoms and quality of life in older adults. *Maturitas*. 2017;106:92-4.
  36. Ishizaki T, Watanabe S, Suzuki T, Shibata H, Haga H. Predictors for functional decline among nondisabled older Japanese living in a community during a 3-year follow-up. *Journal of the American Geriatrics Society*. 2000;48(11):1424-9.
  37. Dudzińska-Griszek J, Szuster K, Szewieczek J. Grip strength as a frailty diagnostic component in geriatric inpatients. *Clin Interv Aging*. 2017;12:1151-7.
  38. Damayanthi HDWT, Moy FM, Abdullah KL, Dharmaratne SD. Prevalence of malnutrition and associated factors among community-dwelling older persons in Sri Lanka: a cross-sectional study. *BMC Geriatrics*. 2018;18(1):199.