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Association between Hand Grip Strength and Health-Related Quality of Life among Malaysian Middle-Aged Adults

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Abstract

In September 2019, the Deputy Prime Minister of Malaysia announced the government's commitment to legislate an Act to sustain and improve the health-related quality of life (HRQoL) of the elderly. HRQoL refers to the perceived physical and mental health of an individual or a group over time. Hand grip strength (HGS) is an indicator for mobility limitation and HRQoL. This cross-sectional study was performed to examine the association between HGS and HRQoL among 106 adults aged from 30 to 60 years in Universiti Sultan Zainal Abidin (UniSZA), Terengganu. Out of the total sample, 37.7% of respondents were males, and 62.3% were females. The mean age of respondents was 38.44 (7.78) years. Sociodemographic characteristics, anthropometric measurements (weight, height, HGS), protein intake, physical activity (PA) level and HRQoL were assessed. The prevalence of respondents to have normal right HGS was 79.2%, and normal left HGS was 69.8%. The respondents were classified as healthy and unhealthy according to the EQ-5D-5L index score. The prevalence of the healthy group was 67.9%. A significant difference was only found in HGS, protein intake and PA between genders, while a significant association was only found between HGS and PA with HRQoL. The results revealed that HGS is linked with HRQoL, whereas low HGS is related to the impaired status of HRQoL by EQ-5D-5L index score and visual analogue scale (VAS) score in Malaysian males and females. More investigation is warranted to examine the specific plausibility between HGS and HRQoL.

Keywords: Hand Strength, Health-Related Quality of Life, Middle-Aged, Adults

Introduction

Ageing may result in anabolic impairment in skeletal muscles, which further cause the widespread reduction in muscle mass and strength. During ageing, approximately 30% of the peak muscle of an individual is lost. This loss is then exacerbated by poor PA and nutritional status (Mcleod et al., 2016). The demographic changes in Malaysia have pushed the health care systems and physicians to develop alternative solutions further. Proper muscle strength

and muscle mass via exercise or protein-based nutrition are essential to maintain proper body function (Mcleod et al., 2016). Muscle strength or HGS is recommended to be the single marker for the well-being of an individual (Rijk et al., 2016).

Based on the 2011 National Health and Morbidity Survey (NHMS) findings, 20.1% of Malaysian adults admitted to having poor health and the prevalence increased with age from young adults to older adults (Chan et al., 2015). This was caused by the change in lifestyle, such as lack of PAs, increased sedentary behaviours and unhealthy eating habits (Chan et al., 2017). If there are no alternative solutions to reduce the prevalence, the population might suffer from various diseases that can affect their ability to function in their environment and manage their daily life activities (Regardt et al., 2011).

This study focused on the association between HGS and HRQoL among middle-aged Malaysian adults in Kuala Nerus, Terengganu, Malaysia. Anthropometry measurements, such as HGS, weight, height and body mass index (BMI), were measured using a digital weighing machine, stadiometer and digital grip strength dynamometer. Protein intake was calculated using a food frequency questionnaire (FFQ). PA of subjects was assessed with International Physical Activity Questionnaire (IPAQ) by recording the activity done for the past seven days. HRQoL questionnaire was also used to determine the subjects' health status. The current study sought to determine the association between HGS and HRQoL among Malaysian middle-aged adults.

Methods

Participants and study design

A cross-sectional study was performed among 106 staff aged 30 to 60 years from UniSZA, Gong Badak Campus, Terengganu, Malaysia. All staff were screened for eligibility. Participants were eligible for study inclusion if they were aged 30 to 60 years, able to communicate in Malay or English, literate, and provided inform consent. The exclusion criteria included non-Malaysian, pregnant and lecturer in UniSZA. Eligible participants were approached by researchers, who attained informed consent. This study protocol was endorsed by UniSZA Human Research and Ethics Committee (UHREC).

Sample size calculation

The comparing mean formula used to estimate sample size was as shown below (Musa, 2012):

$$n = \frac{2(SD^2)}{\Delta^2} \times (Z_{1-\alpha/2} + Z_{1-\beta})^2$$

Where:

n = sample size required per group
SD = standard deviation (referred from (Kamarul Zaman et al., 2006))
$Z_{1-\alpha/2}$ = 1.96, Type I error (alpha) at 5% (2-sided)
$Z_{1-\beta}$ = 0.80, Type II error at 20% (power= 80%)
Δ = detectable difference (decided to be 5)

Table 1: Sample Size Calculation According to Dominant Hand

	Men	Women
Right hand	$n = \frac{2(9^2)}{5^2} \times (1.96 + 0.80)^2$ = 49.4 person per group	$n = \frac{2(7.6^2)}{5^2} \times (1.96 + 0.80)^2$ = 35.2 person per group

Number of participants = 49.4 + 35.2
= 84.6
≈ 85 participants

Consider 20% of participants as dropout data. Hence, the sample size in this study was 106 participants.

Sampling method

A convenience cluster sampling method was chosen to select samples. The population was divided into groups, and they became the sampling unit.

Data collection

The data collection process was conducted from 01 January 2019 until 31 May 2019 (5 months period). The baseline assessments included an extensive questionnaire, which consisted of sociodemographic profile, FFQ, IPAQ, EQ-5D-5L questionnaire, and a physical assessment including height, weight, HGS.

Hand grip strength (HGS)

HGS was measured using an electronic hand dynamometer CAMRY Model EH 101 (USA). The respondents were asked to squeeze the dynamometer as strong as possible for three seconds. Two measurements were obtained for both hands for two consecutive times alternately, and the average value was taken.

Health-related quality of life (HRQoL) measures

HRQoL was assessed using the EQ-5D-5L questionnaire (Reenen & Janssen, 2015). The participants were instructed to complete the questionnaire themselves. However, the researcher provided help when needed. The EQ-5D-5L is a commonly utilized generic preference-based measure of HRQoL that generates utility scores anchored at 0 for 'dead' and 1 for 'perfect health', which indicate preferences for specific health conditions. The descriptive system has five dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). Each dimension consists of five levels (no problems, slight problems, moderate problems, severe problems and extreme problems). Combining the five dimensions at each of the five levels creates (5^5 =) 3125 distinctive health states. The EQ-5D-5L visual analogue scale (VAS) allows participants to evaluate their overall health condition. Zero refers to the worst imaginable health status, and 100 is the best imaginable health status.

Statistical analysis

Statistical analysis was performed using IBM SPAA Statistics for Windows, Version 22.0 (Armonk, NY) and Nutritionist Pro (Axxya System LLC, Stafford, TX, USA). Data were presented as mean (SD) for normal distribution data and median (IQR) for skewed distribution data. The independent t-test and Mann-Whitney test were applied to compare anthropometric measurement, protein intake, PA and HRQoL between genders. The same tests were also

used to compare BMI, protein intake, PA, and HRQoL among weak HGS respondents. Chi-square test and Spearman's rho correlation were used to test the association between HGS, BMI, protein intake and PA towards HRQoL.

Results

A total of 106 adults aged 30 to 60 years in Kuala Nerus, Terengganu, were recruited for the study. Respondents (n=66) consisted of females (62.3%) and 40 males (37.7%) with a mean (SD) age of 38.44 (7.78) years took part in this study. Anthropometric measurement, PA level and EQ-5D-5L scores of males were higher than those of females, whereas protein intake of females was higher than that of males. Based on the results of the analysis, there were significant differences in right HGS (P<0.001), left HGS (P<0.001), adequate-protein intake (P=0.002), overall, PA (P=0.005), and vigorous PA (P=0.009) among gender; other comparisons (among gender) did not reveal any significant difference.

The right HGS shows a significant difference with BMI classification (P=0.024) and protein intake (P=0.006); however, no significant difference can be found between HGS with PA and HRQoL index scores. On the other hand, the left HGS and PA show a significant association with EQ-5D-5L index score (P<0.05), however, no significant association can be observed in BMI, HGS and protein intake (Table 2). Moreover, the left HGS shows a weak positive correlation with the VAS score (P=0.220, P=0.023) (Table 3).

Table 2: Association of anthropometric measurement, protein intake, physical activity towards HRQoL

Measurement	EQ-5D-5L index score		*P*-value
	Healthy (score=1) n (%)	Unhealthy (score>1) n (%)	
Anthropometric			
BMI (kg/m^2)			
Underweight/normal	34 (69.4)	38 (66.7)	0.765
Overweight/obese	15 (30.6)	19 (33.3)	
HGS_R (kg)			
Weak	13 (18.1)	9 (26.5)	0.319
Normal	59 (81.9)	25 (73.5)	
HGS_L (kg)			
Weak	17 (23.6)	15 (44.1)	0.032*
Normal	55 (76.4)	19 (55.9)	
Protein intake			
Adequate intake	31 (68.9)	14 (31.1)	0.855
Inadequate intake	41 (67.2)	20 (32.8)	
Physical activity			
Low/moderate	42 (58.3)	27 (79.4)	0.034*
High	30 (41.7)	7 (20.6)	

Chi-square test for independence.
*p-value significant at <0.05.

Table 3: Correlation of HGS and HRQoL

Measurement	EQ-5D-5L index score		EQ VAS score	
	ρ	*P*-value	*ρ*	*P*-value
HGS_R	0.161	0.100	0.220	0.023*
HGS_L	0.185	0.058	0.163	0.094

Spearman's rho correlation.
*p-value significant at <0.05.

Discussion

Health-related quality of life (HRQoL) of respondents

The findings provided the first description of adult population health status for Malaysia using the EQ-5D-5L questionnaire. Based on the Korea National Health and Nutrition Examination Survey (KNHANES) 2014–2015, the mean EQ-5D-5L index score for males (0.956) was higher than that of females (0.930). The findings are in line with the results of this study. However, the mean index score of Malaysians is lower than Koreans. In terms of the five dimensions of health, males have higher percentages than females (Haraldstad et al., 2017; Hobbins et al., 2018). In spite of that, females experience more pain/discomfort and anxiety/depression than males (Shafie, Hassali, & Liau, 2011). A case study among Malaysian pilgrims in Mecca showed that the females had higher percentages with no problem in all dimensions of health compared to males (Fatimah et al., 2017). The mean EQ-5D-5L index score (0.914) is comparable to those recently reported findings in Italy (0.915) (Scalone, Cortesi, Ciampichini, Cesana, & Mantovani, 2015) and South Australia (0.91) (McCaffrey et al., 2016) but higher than Poland (0.888) (Golicki & Niewada, 2017). The mean EQ-5D-5L index score and VAS score in this study are different from previous studies as both scores declined with age for both genders. Other than that, the prevalence for adults to have a healthy body status also decreases with the increasing age (Golicki & Niewada, 2017; McCaffrey et al., 2016; Scalone et al., 2015). For age groups and BMI groups, the respondents had higher pain/discomfort and anxiety/depression dimensions than mobility, self-care, and usual activity dimensions. Some respondents complained that they had knee pain caused by their weight, failing to perform PA. At the same time, they tried several ways of reducing their weight, but to no avail. Another possible factor might be because Kuala Terengganu is considered as the most blessed place in Malaysia because the people in this district have the highest ranking in the aspects of life, health, family and community relationships, financial management, community activities, security, provision of community facilities, local authority services, eligibility services and the quality of the environment in the area (Shahar, 2019).

Association between anthropometric measurements, protein intake, and physical activity (PA) towards HRQoL

The association between BMI and HRQoL reported contradicting results compared to previous research. The HRQoL was not caused by the BMI of respondents in this study. When the BMI of respondents increased, the probability of having low self-perceived health status also increased, regardless of age and gender. Obesity might affect one's mobility and pain/discomfort, reduce the ability to perform usual activities and self-care. However, it does not affect anxiety/depression problems (Busutil et al., 2017). Logistic regression shows a significant association between abnormal weight and EQ-5D score. Underweight and overweight elderly tend to have low index and VAS scores (You et al., 2018). Studies showed that excess weight and HRQoL are inversely associated. Those severely obese show a

significantly lower index score than normal-weight participants (Busutil et al., 2017; Jiménez-Redondo et al., 2014). Class II obesity individuals are reported to have 47% higher probability to have worse HRQoL, while obese class III individuals are three times tend to have inferior HRQoL than normal weight individuals (Serrano-Aguilar et al., 2009). A recent investigation reported that dietary supplements might enhance the HRQoL of underweight healthy adults who lose weight by restricting food consumption (Ussher and Swann, 2000).

Research contradicted this finding found that protein intake was associated with HRQoL. As the protein intake increases, the EQ-5D-5L index score for the pain/discomfort dimension decreases. A better HRQoL can be promoted with increasing energy and nutrient intake (Jiménez-Redondo et al., 2014). However, a study in Netherland showed that PA or total protein alone has no relation with HRQoL, but the interaction between PA and total protein intake is positively associated with higher HRQoL (Haaf et al., 2018). Adults with Type 2 Diabetes Mellitus who followed the guidelines for PA were significantly associated with HRQoL. This finding is in accord with the results of this study. Respondents who exceeded the baseline recommendation for PA (≥ 300 MPVA min per week) reported a higher HRQoL score (Thiel et al., 2017). A study in Germany also declared that PA yields a positive association with HRQoL (Draxler et al., 2011). A low PA level may cause a weak HGS. As age increases, physical function and muscle strength decrease, thus resulting in weak physical performances (Azevedo et al., 2007). Performing moderate and vigorous PA weekly is positively correlated with HRQoL (Dimare et al., 2016). Individuals who engage in PA several times per week have an increase in EQ-5D-5L index score and VAS score compared to those who do not perform any PA (Martín-Fernández et al., 2018). Therefore, the German Society recommends practising physical exercise to help in reducing health problems as the martial arts group rates a better HRQoL (Draxler et al., 2011).

Similarly, in this study, HGS was significantly associated with HRQoL. Significant differences were shown in the EQ-5D score when the group was divided into weak and strong HGS, suggesting that muscle strength is essential in influencing HRQoL (Moon et al., 2017). In the KHNANES survey, odds ratio (OR) in males showed a significant linear relationship between HGS and mobility, self-care, usual activity and low EQ-5D dimensions, while females showed a significant linear relationship in all dimensions of EQ-5D and HGS. More EQ-5D index scores increase as HGS increases (Kang, Lim, & Park, 2018). Relative HGS is found to have an inverse association with depression by gender as 56% of relative HGS had effects on 52% of depression (Moon et al., 2017). A finding indicated that men with low HGS have poor HRQoL on mobility and pain/discomfort dimensions, while women with low HGS have poor HRQoL on mobility, usual activities and pain/discomfort dimensions (Kang et al., 2018). Muscle strength can be improved to obtain a better quality of life, and the changes in HRQoL are identified to have a significant positive correlation with physical function (Haraldstad et al., 2017). HGS can reflect muscle strength, which is significantly interrelated with the level of disability and HRQoL (Park et al., 2017). The lower HGS group has typical problems with mobility, usual activities, pain/discomfort, anxiety/depression, and EQ-5D index score. Therefore, HGS is considered the best predictor instrument to predict age-related muscle change and mortality (Hairi et al., 2010; Lee et al., 2017).

Study Limitations and Recommendations

The limitation of the current study was the cross-sectional study design, as it can only be carried out one time and took only a short period. Moreover, there was no follow-up session in this study to observe the changes of HGS and HRQoL of respondents over time. Therefore, the cause and effect relationship between the HGS and HRQoL could not be established. Other than that, FFQ is a self-reported, semi-quantitative tool to assess food intake, and it is time-consuming for one to fill up all items. Besides, the IPAQ, which required the respondents to recall their memory of the last seven days of PA, was also a challenge in this study. This may increase the probability of respondents to under-report or over-report their dietary intake and physical exercise. Furthermore, this study focused on Malaysian middle-aged adults. However, only 116 non-academic Malay staff from UniSZA were included in this study, causing the non-representative population sample of Malaysia. This is so because adults in urban and rural areas and different states and those of different races have different lifestyles; therefore, their BMI, HGS, protein intake, PA and HRQoL might be different from one another.

In future, a large scale random sampling study that involves more respondents can be conducted to generalize the whole population in Malaysia. Ethnicity and age group proportions should be more equalized so that the comparison will be more standardized. Instead of using the FFQ, IPAQ and EQ-5D-5L questionnaire for protein intake, PA and HRQoL assessment, respectively, a one-to-one interview can be done as it is the best way to obtain more accurate results. The questions stated in the questionnaire must be simple and easy to understand. The questionnaires should not include too many items because the respondents will consider it a burden to fill up long and wordy questionnaires. As for the HGS, it is advised that future studies include more left-handed respondents to ensure greater confidence in estimating the normal values and better predictability of HGS patterns across different genders and age groups.

Conclusion

The findings claim that HGS is linked with HRQoL, whereas Low HGS is related to the impaired status of HRQoL by EQ-5D-5L index score and visual analogue scale (VAS) score in Malaysian males and females. More investigation is warranted to examine the specific plausibility between HGS and HRQoL.

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References

Azevedo, M. R., Araújo, C. L. P., Reichert, F. F., Siqueira, F. V., da Silva, M. C., & Hallal, P. C. (2007). Gender differences in leisure-time physical activity. *International Journal of Public Health, 52*(1), 8–15. https://doi.org/10.1007/s00038-006-5062-1

Busutil, R., Espallardo, O., Torres, A., Martínez-Galdeano, L., Zozaya, N., & Hidalgo-Vega, Á. (2017). The impact of obesity on health-related quality of life in Spain. *Health and Quality of Life Outcomes, 15*(1), 1–11. https://doi.org/10.1186/s12955-017-0773-y

Chan, Y. Y., Lim, K. K., Lim, K. H., Teh, C. H., Kee, C. C., Cheong, S. M., Khoo, Y. Y., Baharudin, A., Ling, M. Y., Omar, M. A., & Ahmad, N. A. (2017). Physical activity and overweight/obesity among Malaysian adults: Findings from the 2015 National Health and morbidity survey (NHMS). *BMC Public Health, 17*(1), 1–12. https://doi.org/10.1186/s12889-017-4772-z

Chan, Y. Y., Teh, C. H., Lim, K. K., Lim, K. H., Yeo, P. S., Kee, C. C., Omar, M. A., & Ahmad, N. A. (2015). Lifestyle, chronic diseases and self-rated health among Malaysian adults: results from the 2011 National Health and Morbidity Survey (NHMS). *BMC Public Health, 15*(1), 1–12. https://doi.org/10.1186/s12889-015-2080-z

Dimare, M., Del Vecchio, F., & Xavier, B. (2016). Handgrip strength, physical activity level and quality of life of Judo master competitors. *Rev Bras Educ Fís Esporte, 30*(4), 847–855. https://doi.org/10.1590/1807-55092016000400837

Draxler, T., Ostermann, H., & Honekamp, W. (2011). Relationship between Asian martial arts and health-related quality of life in Germany. *Journal of Public Health, 19*(1), 57–64. https://doi.org/10.1007/s10389-010-0343-9

Golicki, D., & Niewada, M. (2017). EQ-5D-5L Polish population norms. *Archives of Medical Science, 13*(1), 191–200. https://doi.org/10.5114/aoms.2015.52126

Hairi, N. N., Cumming, R. G., Naganathan, V., Handelsman, D. J., Le Couteur, D. G., Creasey, H., … Sambrook, P. N. (2010). Loss of muscle strength, mass (sarcopenia), and quality (specific force) and its relationship with functional limitation and physical disability: The concord health and ageing in men project. *Journal of the American Geriatrics Society, 58*(11), 2055–2062. https://doi.org/10.1111/j.1532-5415.2010.03145.x

Haraldstad, K., Rohde, G., Stea, T. H., Lohne-Seiler, H., Hetlelid, K., Paulsen, G., & Berntsen, S. (2017). Changes in health-related quality of life in elderly men after 12 weeks of strength training. *European Review of Aging and Physical Activity, 14*(1), 10–15. https://doi.org/10.1186/s11556-017-0177-3

Hobbins, A., Barry, L., Kelleher, D., & O'Neill, C. (2018). The health of the residents of Ireland: Population norms for Ireland based on the EQ-5D-5L descriptive system – a cross sectional study. *HRB Open Research, 1*, 22. https://doi.org/10.12688/hrbopenres.12848.1

Jiménez-Redondo, S., De Miguel, B., Banegas, G. J., Mercedes, G. L., Gomez-Pavon, J., & Vives, C. (2014). Influence of nutritional status on health-related quality of life of non-institutionalized older people. *Journal of Nutrition, Health and Aging, 18*(4), 359–364. https://doi.org/10.1007/s12603-013-0416-x

Kang, S. Y., Lim, J., & Park, H. S. (2018). Relationship between low handgrip strength and quality of life in Korean men and women. *Quality of Life Research, 27*(10), 2571–2580. https://doi.org/10.1007/s11136-018-1920-6

Lee, S. H., Kim, S. J., Han, Y., Ryu, Y. J., Lee, J. H., & Chang, J. H. (2017). Hand grip strength and chronic obstructive pulmonary disease in Korea: An analysis in KNHANES VI. *International Journal of COPD, 12*, 2313–2321. https://doi.org/10.2147/COPD.S142621

Martín-Fernández, J., Ariza-Cardiel, G., Polentinos-Castro, E., Sanz-Cuesta, T., Sarria-Santamera, A., & del Cura-González, I. (2018). Explaining differences in perceived health-related quality of life: a study within the Spanish population. *Gaceta Sanitaria, 32*(5), 447–453. https://doi.org/10.1016/j.gaceta.2017.05.016

McCaffrey, N., Kaambwa, B., Currow, D. C., & Ratcliffe, J. (2016). Health-related quality of life measured using the EQ-5D-5L: South Australian population norms. *Health and Quality of Life Outcomes, 14*(1), 1–12. https://doi.org/10.1186/s12955-016-0537-0

Mcleod, M., Breen, L., Hamilton, D. L., & Philp, A. (2016). Live strong and prosper : the importance of skeletal muscle strength for healthy ageing. *Biogerontology, 17*(3), 497–510. https://doi.org/10.1007/s10522-015-9631-7

Moon, J. H., Kong, M. H., & Kim, H. J. (2017). The association between hand grip strength and health-related quality of life in Korean adults. *The Korean Journal of Sport Medicine, 35*(2), 103–111.

Park, S., Han, H. S., Kim, G. U., Kang, S. S., Kim, H. J., Lee, M., Park, S. H., Choi, K. H., Kim, S. H., & Yeom, J. S. (2017). Relationships among disability, quality of life, and physical fitness in lumbar spinal stenosis: An investigation of elderly Korean women. *Asian Spine Journal, 11*(2), 256–263. https://doi.org/10.4184/asj.2017.11.2.256

Reenen, M. V., & Janssen, B. (2015). *EQ-5D-5L User Guide* (Version 2). EuroQol Research Foundation. https://euroqol.org/publications/user-guides

Regardt, M., Henriksson, E. W., Alexanderson, H., & Lundberg, I. E. (2011). Patients with polymyositis or dermatomyositis have reduced grip force and health-related quality of life in comparison with reference values: An observational study. *Rheumatology, 50*(3), 578–585. https://doi.org/10.1093/rheumatology/keq356

Rijk, J. M., Roos, P. R. K. M., Deckx, L., Van den Akker, M., & Buntinx, F. (2016). Prognostic value of handgrip strength in people aged 60 years and older: A systematic review and meta-analysis. *Geriatrics and Gerontology International, 16*(1), 5–20. https://doi.org/10.1111/ggi.12508

Scalone, L., Cortesi, P. A., Ciampichini, R., Cesana, G., & Mantovani, L. G. (2015). Health related quality of life norm data of the general population in Italy: Results using the EQ-5D-3L and EQ-5D-5L instruments. *Epidemiology Biostatistics and Public Health, 12*(3). https://doi.org/10.2427/11457

Serrano-Aguilar, P., Muñoz-Navarro, S. R., Ramallo-Fariña, Y., & Trujillo-Martín, M. M. (2009). Obesity and health related quality of life in the general adult population of the Canary Islands. *Quality of Life Research, 18*(2), 171–177. https://doi.org/10.1007/s11136-008-9427-1

Shafie, A. A., Hassali, M. A., & Liau, S. Y. (2011). A cross-sectional validation study of EQ-5D among the Malaysian adult population. *Quality of Life Research : An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 20*(4), 593–600. https://doi.org/10.1007/s11136-010-9774-6

Shahar, M. A. (2019). Kuala Terengganu kawasan PBT paling bahagia - kajian. Kuala Terengganu, Malaysia. *Malaysiakini*. https://www.malaysiakini.com/news/469083

Fatimah, S. M. N., Rosminah, M., Suhaimi, A. W., & Omar, O. (2017). The measurement of quality of life among population within the crowd: A case study among Malaysian Pilgrims in Makkah. *Malaysian Journal of Public Health Medicine, 17*(1), 137–145.

Ten Haaf, D. S. M., van Dongen, E. J. I., Nuijten, M. A. H., Eijsvogels, T. M. H., de Groot, L. C. P. G. M., & Hopman, M. T. E. (2018). Protein Intake and Distribution in Relation to Physical Functioning and Quality of Life in Community-Dwelling Elderly People: Acknowledging the Role of Physical Activity. *Nutrients, 10*(4), 1–13. https://doi.org/10.3390/nu10040506

Thiel, D. M., Al Sayah, F., Vallance, J. K., Johnson, S. T., & Johnson, J. A. (2017). Association between Physical Activity and Health-Related Quality of Life in Adults with Type 2 Diabetes. *Canadian Journal of Diabetes, 41*(1), 58–63. https://doi.org/10.1016/j.jcjd.2016.07.004

Ussher, J. M., & Swann, C. (2000). A double blind placebo controlled trial examining the relationship between Health-Related Quality of Life and dietary supplements. *British Journal of Health Psychology, 5*(2), 173–187. https://doi.org/10.1348/135910700168847

You, H., Li, X. L., Jing, K. Z., Li, Z. G., Cao, H. M., Wang, J., Bai, L., Gu, J. H., Fan, X., & Gu, H. (2018). Association between body mass index and health-related quality of life among Chinese elderly - Evidence from a community-based study. *BMC Public Health, 18*(1), 1–9. https://doi.org/10.1186/s12889-018-6086-1