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PREVALENCE OF FOOD INSECURITY AND ITS ASSOCIATION WITH MUSCLE MASS, HAND GRIP STRENGTH AND GAIT SPEED AMONG ELDERLY IN TEHRAN

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ABSTRACT: Background: Human muscle mass undergoes constant changes as one getting older. This change can be accelerated by inadequate nutrition. The aim of the study is to investigate the association between food insecurity and its association with muscle mass strength. **Methods:** The cross-sectional and case-control study was conducted among 310 men and 334 women (60 and over) from August 2014−July 2015 in Tehran. A pilot study was conducted before initiation of the study to validate equipment. Food insecurity data were collected using Household Food Insecurity Access Scale. Muscles mass strengths were analyzed by Bioelectronics impedance analysis, Squeeze bulb dynamometer. **Conclusion:** Elderly people living in food insecurity status had scored lower mean standard deviation of muscle mass strength. Food security is a key factor to sustainin c7489-02), and the 6-step walk test. Association between food insecurity and other variables were analyzed by SPSS software. **Results:** Findings showed that food insecurity prevalence was (29%). It also showed (10%) elderly women and (21%) men had low muscle mass, (24.3%) elderly women and (19.4%) men had a lower hand grip strength and a (21.9%) had low gait speed and the difference was significant (*P-value <.001)*. The risk of having weak hand grip strength is 5.8 times higher in men in (model 1), 11.5 times higher in women (model 2) and 5.5 higher in men in (model 3). The risk of fallen more likely occurs in women compared to men. g muscle mass strength and physical performance. It helps to maintain healthy aging and improves quality life.

INTRODUCTION: Food insecurity is a pressing social and public health issue that varies in degree and in its effects on individuals and social groups.

For this reason, it is critical to understand how patterns of food insecurity appear across differing demographics in order to meet specific needs through the implementation of appropriate policies, programs, and other initiatives. The USDA defines food insecurity as "the state of being without reliable access to a sufficient quantity of affordable, nutritious food." There are four key terms in that definition: access, sufficient quantity, affordable and nutritious. Of these, "affordability" has received the most attention.

Past literature on food insecurity in the United States and even all over the world has focused heavily on children and single parent households, which is appropriate because research shows that young, low-income families with children are perhaps the most food insecure population in the world. Less is known about food insecurity in other potentially vulnerable populations of elderly. Food insecurity is a social, cultural or economic state and as such is simpler to conceptualize and measure (a report submitted to American Association of retired Person foundation, September 2014).

Food insecurity entails a much wider and often more systemic problem than "hunger" describes. Unlike hunger, it is not a temporary state or sensation (a report submitted to AARP Foundation, September 2014). A study conducted in different cities of Iran in 2013 by different authors the food insecurity percentage were reported as (%30.5) in Yazd, (%36.6) Isfahan, (%50.5) Shahr-e Ray, and (%36.3) Asadabad [1-5]. Two studies conducted in the USA on factors associated with food insecurity among US elderly persons by Lee(2001) and Seasonal variation in food insecurity association with heating and cooling costs among low-income elderly Americans by Nord (2006) showed the prevalence food insecurity was 1.7% and 3.7% [6,7].

In addition, human muscle undergoes constant changes. After about age 50, muscle mass decreases at an annual rate of 1–2 %. Muscle strength declines by 1.5 % between ages 50 and 60 and by 3 % thereafter. On the average, 5–13 % of older persons over 60 years of age have low muscle mass, with the prevalence increasing to as high as 50 % in persons over the age of 80 years [8, 9]. Normal aging is associated with approximately a 1% loss of muscle from 30 years of age, and this loss tends to accelerate after the age of 70 years [10]. Coin et al. found that about 20 % of community-dwelling persons in Italy had low muscle mass [11, 12]. In Barcelona, the low lean mass was present in 33 % of elderly women and 10 % of males [13]. In Taiwan, low muscle mass was present in 2.5%of community-dwelling women and 5.4 % of males [14]. The ability to grip is also one of the most important functions of the hand, and grip strength can be used to reflect overall muscular strength [15]. Several studies have shown that grip strength is inversely associated with all-cause mortality, functional impairments, frailty markers, cognitive impairments, physical disabilities, and nutritional status [16-18]. The similar study in Korea also showed that it has been found to be associated with numerous factors such as demographics characteristic (age and gender). As the study showed the mean grip strength in healthy Caucasian elderly adults was about 41% less in women (right 29 kg; left 27 kg) than in men (right 49 kg; left 47kg) resulting in a ratio of left to right hand slightly above .95 in both genders [19]. Gait speed is a quick, inexpensive, reliable measure of functional capacity with well documented predictive value for major health-related outcomes. Humans can walk up to 4 m/s [20], but natural transition between walking and running is roughly 2.2 m/s [20-23].

This study is a first in kind in Iran to identify the relationship between food insecurity and associated factors such as muscle mass, hand grip strength and physical performance of elderly. We think the results of this study will contribute and add new knowledge for a researcher in the field, health professional and will also help Ministry of Health, Government, and all concerned bodies to give due attention so as to improve the quality life of elderly. The aim of the study is to investigate food insecurity prevalence and its association with muscle mass, hand grip strength and physical performance.

METHODS:
Ethical approval was secured from the ethics Committee and Vice Chancellor for research at Tehran University of Medical Sciences. The approval is in accordance with the tenets of the Helsinki Declaration and the national ethical guideline for medical research with ethical approval Code: IR.TUMS.REC.1394.346. Then, a pilot study was conducted to validate instruments. Strict inclusion and exclusion criteria were established. To be eligible for study participants must be 60 years and over and should not take any supplementation drugs. They should able to move without any support and should free from any chronic illness. Furthermore, each participant was explained about the objective of the study, they

completed and signed consent by their willingness. Then, a cross-sectional study design was conducted to identify the prevalence of food insecurity and participants were recruited for the second part of the study design which is a case-control.

The reason for case-control was to compare the proportion of food insecurity in those who have normal muscle mass strength and who don't. The sample size was determined using a single proportion formula for cross-sectional studies while for case-control it determined by comparing two populations estimation P_1 and P_2 (95% Confidence level and 80% power). The study was conducted from August 2014−July 2015 in six randomly selected health centers in Tehran using cluster sampling method. Ten percent of 60 diagnostic health centers were identified and six health centers were randomly selected using the simple random sample. Then the study participants were recruited via phone call. Participant's phone numbers were already recorded at the nearby health center. When there were two elderly people in the same house, only one person was selected randomly to participate in the study. When there was more than one eligible in the same house, only one person was selected.

In the case of no any eligible person was found in the selected household, the interviewer would take the next phone call. **A** totally, 310 men and 334 women (60 and over) were studied. A standard questionnaire was used to collect data. Questionnaires were first written in English and then translated to Persian language and back to English to attest comparability. The questionnaires were contained questions related to socio-demographic characteristics such as gender, age, educational level, occupation and food insecurity. The questionnaire also involved information regarding their health status and lifestyle.

Food insecurity information was collected using a standard semi-quantitative questionnaire which was developed by the USAD Household Food Insecurity Access Scale (HFIAS). All anthropometric measures such as height, hip, waist, wrist, ankle, knee, and arm, thigh, upper and median (in meter) were entered into the software. Other measurements such as weight (in Kg) and

body mass index were calculated by the same software. Muscle mass, handgrip strengths, and gait speed were analyzed by Bioelectronics impedance analysis (BIA), Squeeze bulb dynamometer (c7489-02), and the 6-step walk test respectively. The relationship between Food insecurity and muscle mass strength was analyzed by SPSS software version 22.

Data analysis:
First, pre-coded data were entered into the computer and analyzed using SPSS version. Correlation between food insecurity with other variables such as sex, age, muscle mass, hand grip strength and gait speed was investigated by a bivariate analysis. The mean scores of variables mentioned above were also explored with independent sample-t-test. Odds ratio and 95% confidence interval were computed by logistic regression to test models and predict categorical outcomes of food insecurity with sex, age, muscle mass, hand grip strength and gait speed.

RESULTS:
A total of 310 men and 334 elderly women (60 years old and over) participated in the study with a mean age value (70.8 ± 6.1). The findings of this study showed (10%) women and (21%) elderly men had low muscle mass, whereas (24.3%) elderly women and (19.4%) men had low hand grip strength and also (21.9%) elderly had low gait speed. The mean standard deviation of muscle mass, hand grip strength and gait speed among the study population was (20.4±5.1 (kg), 23.4±6.4 (kg) and 0.65±0.21 (kg) respectively and the difference was significant (*P-value <.001)*.

Findings showed that the total food insecurity prevalence among study participants was (29%), marginal food insecurity was (13.2%), low food insecurity was (9.9%) and very low food insecurity was (5.9%). It also showed that there was no one of the elderly men and women's counterpart who were living in similar food security status had low muscle mass while (20.2%) of elderly men and (20%) women who were living in marginal food insecurity had low muscle mass. Furthermore, (16 %) men and (18.6%) elderly women who were living in similar low food insecurity status had low muscle mass compared to (36.7%) of the elderly

men and (28.6%) women, who were living in the very low food insecurity condition had low muscle mass. In addition, the findings revealed that (8.1%) of elderly men and (5.8%) of elderly women who were living in a similar food security status had low hand grip strength.

A similar result was observed among elderly men and women who were living in a marginal food insecurity condition where they had (16.1%) and (13.5%) low hand grip strength respectively. It also showed (24.8%) of elderly men and (19 %) of elderly women who were living in low food insecurity situation had low hand grip strength while (32.1%) men and (26%) women who were living in very low food insecurity had low hand grip strength. Finally, findings showed (21%) elderly people, both men and women who were living in similar food security status had low gait speed whereas (15%) of elderly, who were living in marginal food insecurity had low gait speed.

In addition, (25.7%) of elderly people who were living in low food insecurity had low gait speed while (48.6%) of elderly, who were living in very low food insecurity had low gait speed. In addition, before adjusting all important variables (model 1) the odds ratio for food insecurity in men with low hand grip strength was 5.9 with (P-value < .001 with 95% Cl = 3.47-10.03).

When adjusting for other variables (model 2), the odds ratio for food insecurity in men and women with low hand grip strength was 6.1 and 11.5 respectively (P-value <.001 with 95%Cl = 2.92-45.02). When adjustment was done for all other variables except age (model 3) the odds ratio for food insecurity in men and women with low hand grip strength was 5.46 and 3.12 (P-value <.001 and <.005 with 95%Cl = 3.26-9.16 and 1.56-6.25 respectively). All other variables are equal.

TABLE 1: SHOWS THE SUMMARY STATISTICS DATA PROFILE OF THE STUDY PARTICIPANTS

T-test mean scores of muscle mass, hand grips strength and Gait speed data profile of elderly people						
Gender:	N	Mean(kg)	Std. Dev (kg)	P-value	Mean difference	95%CI
Males	310	1.94	0.23	<.001	0.09	.05-.15
Females	334	1.84	0.36	<.001		
Muscle mass data:						
males	310	3.04	0.23	<.005	0.6	.02-.101
females	334	2.97	0.3	<.005		
Hand grip strength:						
males	310	1.44	0.25	<.001	0.03	.31-.44
Females	334	1.06	0.51			
Gait speed:						
males	310	194	0.23	<.001	0.09	.04-.14
females	334	1.84	0.36	<.001		
Age group:						
males	310	1.48	0.51	<.001	0.37	.31-.44
females	334	1.1	0.32	<.001		

TABLE 2: COMPARISON OF FOOD INSECURITY PROPORTION IN CASE AND CONTROL GROUPS BETWEEN NORMAL AND LOW MUSCLE MASS, HAND GRIP STRENGTH AND GAIT SPEED.

Comparison of Food Insecurity proportion in case and control groups between normal and low hand grip strength			
Variables	Control groups	Case groups	
Gender	Normal hand grip(%	Low hand grip(%)	P-value
Men	141(24.1)	268(41.6)	<0.001
Women	1(0.2)	78(30.7)	
Comparison of Food Insecurity proportion in case and control groups between normal and low muscle mass			
Variables			
Gender	Normal muscle mass (%)	Low muscle mass (%)	P-value
Men	132(42.5)	178(53.3)	0.005
Women	166(49.7)	168(50.2)	
Comparison of Food Insecurity proportion in case and control groups between normal and low Gait speed			
Variables	Normal Gait speed	P-value	
Both gender	50.5 55.9	<0.001	

N: B.Hence, there is no International Standard cut-off point for educational level and occupation regarding normal or low muscle mass, hand grip strength, and gait speed it is difficult to categorize as a case and control.

DISCUSSING: The findings of this study show that (10.3%) of elderly women and (21.9%) of elderly men had low muscle mass with a mean standard deviation of muscle mass (men: 3.04±0.23 and women: 2.97±.30) and the difference is significant (*P-value < 0.001*). This study is in line with a study conducted in community-dwelling people in Italy and showed (20%) of elderly men and women had low muscle mass [5].

Present findings also are supported by a similar study conducted in Barcelona, where (33%) of elderly women and (10%) of males had low muscle mass [6]. Our findings also have been higher than a similar study conducted in Taiwan, which showed (2.5%) of community-dwelling women and (5.4 %) of males had low muscle mass [7]. Findings show a strong positive significant association between food insecurity with muscle mass, hand grip strength and physical performance with P-value < .005, < .001, = .02 respectively. This finding is in line with a similar study conducted in Indonesia in which muscles hand grip strength was revealed significantly associated with age (P-value <.001). Present findings show that (24.3%) of women and (19.4%) of elderly men had low hand grip strength with the mean and standard deviation (men: 1.44±0.25 and women: 1.06±0.51) and the difference is significant (*P-value < 0.001*).

This shows the mean hand grip strength is relatively higher in men than elderly women. This finding disagrees with a study conducted among healthy Caucasian adults, which reported 41% less in women (right 29 kg; left 27 kg) than in men (right 49 kg; left 47 kg) resulting in a ratio of left to right hand slightly above .95 in both genders [12]. Our study findings show (21.9%) of elderly people have low gait speed with the mean and standard deviation (men: 1.94±.23 and women: 1.84±0.36) and the difference is significant (*P-value < 0.001*). The mean and the standard deviation are relatively same in both genders. The logistic regression analysis (model 1) showed that the odds ratio for food insecurity in men who have low hand grip strength was 5.9 with (P-value < .001 with 95%Cl = 3.47-10.03), before adjusting for all other variables. After adjusting the other variables (model 2), the odds ratio for food insecurity in men and women with low hand grip strength was 6.1

and 11.5 respectively (P-value <.001 with 95%Cl = 2.92-45.02). Moreover, adjustment for all other variables except age (model 3) the odds ratio for food insecurity in men and women who have low hand grip strength was 5.46 and 3.12 (P-value <.001 and <.005 with 95%Cl = 3.26-9.16 and 1.56-6.25) respectively. These findings show that the risk of having weak hand grip strength is 5.8 times higher in men in (model 1), (11.5) times higher in women in (model 2) and 5.5 higher in men in (model 3). To compare and discuss these results with another similar study, we couldn't find similar ones.

In addition, the prevalence of food insecurity, in general, was (29%), and for the marginal food insecurity, it was (13.2%), for low food insecurity was (9.9%) and very low food insecurity was (5.9%). This result is relatively in line with a similar report from the USA where (7.3%) of elderly people were marginally food insecurity, (6.1%) has low food security, and (3.9%) of them have very low food security (a report submitted to AARP Foundation, September 2014). The findings of this study are much lower than a similar study conducted in Yazd (30.5%), Isfahan (36.6), in Shahr-e Ray, and Asadabad 36.3% [1-5]. But it is unlike other two studies conducted in the USA which reported the prevalence of food insecurity as 1.7% and 3.7% respectively [6, 7]. This indicated that the prevalence of food insecurity in our study is high. Another study conducted in Turkey reported that food insecurity prevalence was (43.5%) among the age group 60 to 69 years old and 33.3% in those age group 70 years and over [8].

This study is the first study in the World that investigates the association between food insecurity and muscle mass, hand grip strength, and physical performance. This makes it difficult to compare and discuss our results with another study. The other limitation of this study is that during the data collection period some of the elderly people could not able to come to health centers. For this reason, it was difficult to estimate the exact prevalence of food insecurity and other variables under study. A pilot study was conducted before commencing the main study to validate the scale reliability and validity measurements. Daily field supervision and data check up was taking place as a follow-up

method. In conclusion, Food security is an important key factor to sustaining muscle mass strength and physical performance. There is a significant association between food insecurity, muscle mass, hand grip strength and physical performance (P-value <.001). Therefore, Minister of Health, Government, the non-government organizations need to intervene and give due attention to the elderly people so as to improve the elderly person's quality life and avert the prevalence of food insecurity and other related factors.

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