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Submitted in partial requirements  
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**Title:** Polypharmacy and Nutritional status in the elderly at Eric Williams Medical Sciences Complex

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Department of Agricultural Economics & Extension  
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POLYPHARMACY AND NUTRITIONAL STATUS IN THE ELDERLY AT ERIC  
WILLIAMS MEDICAL SCIENCES COMPLEX

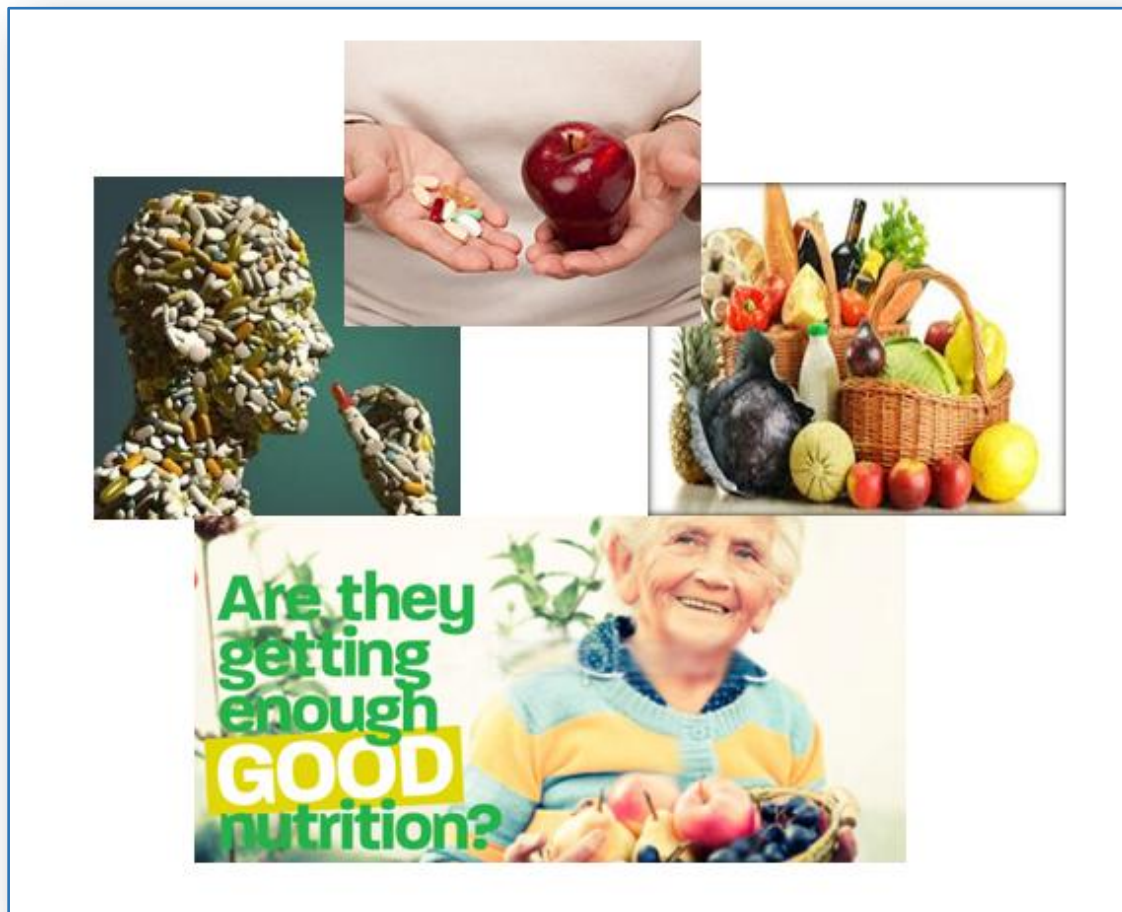
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Parbatie Ramnarine

Supervised by Dr. Selby Nichols

2014

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## ABSTRACT

**Background:** The prevalence of malnutrition and polypharmacy are very common issues among the elderly, with possible negative effects on their functional and cognitive capacity. Many factors may influence malnutrition in the elderly including the natural ageing process, a sedentary lifestyle, social isolation, loneliness, depression, comorbidities and the consequent intake of multiple medications. This, in addition to the study design of current studies, makes it very difficult to investigate the independent role of polypharmacy in nutritional status and thus research on their relationship is very limited.

**Objectives:** The purpose of this study is to determine whether there is a difference in nutritional status between the polypharmacy and non-polypharmacy users among the elderly age 65 and over.

**Methods:** A case-control study was conducted at the out-patient pharmacy at the EWMSC, Trinidad and Tobago. Interviewer-administered questionnaires were used on 103 participants that were recruited. The questionnaire comprised of 5 parts: demographics, medication information, the MNA tool, food frequency and lifestyle. Data was entered into SPSS version 20 for analyses.

**Results:** The study found that polypharmacy users had lower MNA scores than the non-polypharmacy users and thus significantly more likely to be malnourished or at risk of it (31.6% vs 13.0%,  $p = 0.035$ ). The polypharmacy participants were also less likely to be involved in exercise routines. It also found that polypharmacy was more present in the East Indian descent compared to the Africans and Info-Africans. Being overweight ( $BMI \geq 25$ ) was found to be associated with high serum cholesterol levels and diabetes mellitus.

**Conclusion:** There exists a significant difference in nutritional status among polypharmacy and non-polypharmacy users. Persons age 65 and older who use 6 or more medications are more likely to be malnourished or at risk of it than those who use less than 6 medications.



## INTRODUCTION

Nutrition in the elderly has developed into a topic of increasing concern over the past decades mainly due to the high prevalence of malnutrition (35%, Wells and Dumbrell, 2006) among this population. According to the World Health Organization (WHO), the global demographic shift in the proportion of older persons continue to escalate, instigating a lot of research to be centred on them. Nutritional status is the extent to which nutrients are available to meet the metabolic needs of the individual (Medical Dictionary) and this need varies throughout the lifecycle depending on one's age, medical condition and lifestyle. The aging body undergoes physiological changes causing nutrition to become a bit challenging for persons age 65 and above since it impacts severely on general food intake, the digestion of food, the absorption of nutrients and the excretion of waste from the body.

Sensory impairment in the elderly affects food intake in several ways. A diminished sense of taste possibly caused by a reduced number of taste buds and an altered sense of smell caused by modifications in the olfactory epithelium, receptors and neural pathways (Ahmed & Haboubi, 2010) makes eating less appealing for the elderly. A loss of vision and hearing reduces the elderly's independence in procuring and preparing foods of their preference. Dentures, dental decay and lack of teeth, which are common in the elderly reduces their ability to chew food and break it down mechanically. Dry mouth, or xerostomia, another common complaint among the elderly is derived from a decrease in the production of saliva, a fluid in the oral cavity that commences the chemical digestion of starch and fats as food is chewed. This, in addition to other oral problems, may make chewing and swallowing difficult. As such, fewer variety of foods may be consumed and extra salt, sugar, spice or fat may be used to enhance its flavour, thus contributing to a poorer nutritional status in the elderly.

Gastrointestinal changes in persons over age 65 negatively affects digestion of food and the absorption of nutrients. The production of hydrochloric acid is commonly reduced in the elderly.

This compromises the sterility of the stomach's environment, thus facilitating the growth of small bowel bacteria and this in turn, is associated with reduced body weight and intake of micronutrients (Ahmed & Haboubi, 2010). Reduced gastric acid also limits the absorption of vitamins and minerals such as Vitamin B12 and iron. A deficiency of Vitamin B12 can lead to depression, memory loss and dementia whilst low iron can cause anaemia where the individual may experience severe fatigue and loss of appetite.

Ageing is associated with a slower gastric emptying so that the person feels less hungry and for a longer period. It also makes the person feel satiated earlier whilst having a meal thus lowering the desire to eat. Peristalsis, the movement of food throughout the intestines, may also be slower resulting in constipation and bloating. This will affect food intake. A reduced fluid intake can also have the same effect. Fluid loss is also promoted when the kidney does not function properly, another impairment that accompanies old age. The kidney's sensitivity to the antidiuretic hormone is reduced therefore increasing the loss of fluid in the urine.

Additionally, the ageing population often experiences a progressive depletion of lean body mass called sarcopenia and this may be the result of reduced activity levels, illnesses and hormonal changes (Andrew, 2014). This decreases basal metabolic rate so that calories from food are burnt at a slower rate enhancing the accumulation of body fat. This then predisposes the individual to certain chronic diseases. A loss of lean body mass thus weakens the elderly and impairs their functional ability.

Apart from the many physiological changes that occur during the advanced ageing process, there are other factors that may affect the nutritional status in elderly such as a sedentary lifestyle, social isolation, loneliness, depression (Culross, 2008) and diseases. Medications used in the treatment of these disease in the elderly are processed differently in their bodies due to the age related changes that occur mostly in the digestive system, the liver and the kidneys. Generally, when medications enter the body, they are firstly absorbed, then distributed into the blood

stream, metabolized in the liver and then eliminated via the kidney. In the elderly, the medications are absorbed at a slightly slower rate because of reduction in gastric acid and intestinal blood flow. Other factors affecting the absorption are the type of food consumed, whether the drug is taken on a full or empty stomach, the presence of other drugs in the stomach and any other condition that the individual may have. This can influence the time taken for the drug to act in the body. Some medications then enter the bloodstream for distribution into various organs and tissues whilst others may first be broken down by the liver before being distributed. Where the drugs goes and how much of it goes are affected by the amount of body fat, intracellular fluid content, plasma albumin levels and the amount of blood flow to the various sites. The increased body fat and reduced body water facilitates the distribution of more fat soluble drugs than water soluble drugs thereby increasing the duration of action of the drug. A lowered albumin level in the blood causes less binding of the drugs resulting in more free and active drugs being available for the organs or tissues, thereby rendering a lower dose of medication for the elderly. During this stage, when there is an increase of free drugs in the bloodstream, interaction with other drugs can occur if multiple drugs are taken and drugs can enter other organs and tissues other than the ones targeted. This can lead to an increase in side effect and the severity of it as well. Again, this affects the overall health of the elderly. The liver then breaks down the drug in a form that can be easily and safely eliminated from the body. The reduced hepatic blood flow in the elderly carries the drugs much slower to the liver and the reduced enzymatic activity and liver mass affects the liver's ability to metabolize the drugs. As such, clearance of the drug or its metabolites becomes problematic increasing the potential for more adverse drug reactions to occur. Finally, the kidneys eliminate drugs from the body via the urine. A reduced kidney function in the elderly alters this excretion process resulting to an accumulation of metabolites in the body which can be toxic and further promotes adverse drug reactions which can be detrimental to the elderly.

Furthermore, multiple co-morbidities commonly present in the elderly, exposes them to multiple therapeutic regimes and thus a greater risk for polypharmacy (Barnett, 2009). Polypharmacy generally means taking multiple unnecessary medications however, for the purpose of this paper, polypharmacy will refer to the concurrent use of six or more medications since a literature review done by Bushardt et al (2008) revealed that the two most commonly cited definitions include “use of a potentially inappropriate drug” or “use of six or more concomitant drugs”. If these multiple medications are not managed properly to maximize their benefit, then they can cause adverse drug effects which can further compromise nutritional status in the elderly. A combination of drugs are more likely to affect food intake by causing a greater number of side effects such as nausea, vomiting, loss of appetite, xerostomia, dizziness and dehydration to name a few. Its combined effect is also more likely to increase drug toxicity in the body and more likely to alter the processing of foods and the utilization of nutrients in the body. Several studies conducted in various parts of the world have shown that polypharmacy is very prevalent among the elderly, a proportion of the population in Trinidad and Tobago that has risen from 5.6 percent in 1980 to 9.0 percent in 2011 (CSO, 2011), however, this topic has not yet been explored here.

There has been a global concern for the increasing use of medications among the geriatric population because of the overall negative effect it may have on their health. Malnutrition is one of these effects and is defined as any disorder of nutritional status, including disorders resulting from deficiency of nutrient intake, impaired nutrient metabolism or over-nutrition (Di-Maria-Ghalili, 2012). Due to the great number of factors that can contribute to the development of malnutrition in the elderly, a variety of nutritional screening tools has been developed to determine malnutrition or those at risk of malnutrition in the elderly. Each assessment tool has been designed to accomplish a specific goal in a particular setting. The NRI- Nutritional Risk Index- and the GNRI- Geriatric Nutritional Risk Index are based on biochemical and clinical indices, applies to hospital settings and are both aimed at detecting malnutrition and its

association to postoperative complications. SGA-Subjective Global Assessment- is aimed at detecting overt nutrition in a hospital or clinical setting and NRS 2002 –Nutritional Risk Screening 2002- detects malnutrition and identifies patients who need closer monitoring. They both combine data on medical history, clinical and subjective evaluation of the patient. MNA-Mini Nutritional Assessment- and its short form (MNA-SF) are based on anthropometry, mobility, cognitive state, and self-perception of health and nutrition and detects malnutrition specifically in the elderly. The MNA has been validated in all settings (Poulia et al, 2012). MUST-Malnutrition Universal Screening Tool-detect malnutrition in the entire adult population. MUST consists of the parameters BMI, weight loss and acute disease. The MNA long version has been used in this study to assess nutritional status in the elderly.

Although few studies (using cross-sectional design) show the association between polypharmacy and malnutrition there is still limited evidence on the independent role of polypharmacy on nutritional status (Jyrkka et al, 2012). This study, however, uses a case control design and proposes to determine whether a difference in nutritional status exists among the elderly between the polypharmacy and non-polypharmacy users, thus strengthening that link if an association is reported. It seeks to answer the question whether persons age 65 years and older who are taking 6 or more medications are more likely to be malnourished than those individuals who take less than 6 medications.

## LITERATURE REVIEW

Polypharmacy and malnutrition are two occurrences among the elderly that has raised international concerns due to the associated poor quality of life manifested as a declined functional and cognitive ability. Since malnutrition can be influenced by a great number of factors such as ageing, disease state and the overall physical, mental and psychosocial status of the individual, it is very difficult to determine the independent role of polypharmacy in malnutrition. The importance of this topic should not be underestimated as the elderly is very vulnerable to malnutrition or is at risk of it and this can have detrimental impacts on their overall health and mortality. This study will examine the nutritional status of both polypharmacy and non-polypharmacy users as both these phenomena are pertinent issues in the geriatric population. Malnutrition is well known among the elderly. After administering the Mini Nutritional Assessment (MNA) to 4507 elderly persons from 12 different countries in 4 different settings (hospital, rehabilitation, nursing home, community) Kaiser et al (2010) found that the prevalence of malnutrition was 22.8 % (with community setting being 5.8%) whereas those who were at risk of malnutrition was 46.2%. However, Bokhorst-de van der Schueren et al (2010), who also used the MNA but at a geriatric out-patient department in the Netherlands, found that the prevalence of malnutrition was 17% and the “at risk” group was as high as 58% .To further support the extent of malnutrition in the elderly, Jyrkka et al (2012), who did a review summarizing the evidence of polypharmacy and nutritional status in the elderly, found that 13-34% of community dwelling elderly are either malnourished or at risk of it. This study will also be using out-patients but it will be based at an institutionalized pharmacy. The high range of prevalence values for malnutrition deems the study very important and relevant since malnutrition negatively affects the health status of the elderly.

The current research is focused on the elderly because this group of individuals continues to rise across the globe. According to United Nations report on World Population Ageing (2013), the

proportion of the world's population aged 60 years or over increased from 8 per cent in 1950 to 12 per cent in 2013 with a projected to substantial increase to 21 per % by the year 2050. It also stated that the older persons are more concentrated in the less developed countries and is growing faster than in the more developed regions. In line with this population increase, the Central Statistical Office (2011) in Trinidad and Tobago (a less developed country) reported that persons age 65 years or older rose from 5.6% in 1980 to 9.0% in 2011. Hence the relevance of research in this proportion of the population.

A study done by Bushardt et al (2008) on 1270 outpatients, 65 years or older, from more than 500 outpatient clinical sites in South Carolina, concluded that 29.4% were prescribed 6 or more concurrent drugs. Moreover, 15.7% (199 patients) were prescribed one or more potentially inappropriate drug, a more sensitive used criteria to determine the prevalence of polypharmacy. Another study done by Heuberger & Caudell (2011) in 1065 community dwelling individuals, age greater than 65 years, found that 22.2% (236 persons) were taking five or more medications; the number of medications used to determine polypharmacy was different in this case as well as the setting but it still substantiates the claim that polypharmacy is very prevalent among the elderly. In fact, it was concluded by Hovstadius et al (2010) that the prevalence of polypharmacy is actually increasing among the general population; the prevalence increased by 8.2% for those taking 5 or more medications and 15.7% for those taking 10 or more medications (which was termed excessive polypharmacy); the research was based on a Swedish population over four 3 month period between 2005 and 2008. It was also reported that the largest increase for excessive polypharmacy was seen in individuals age 70 and above, giving further evidence of polypharmacy in the elderly and thus the relevance of the topic.

From the very few studies that have been conducted to examine the relationship between polypharmacy and nutritional status, most of them have used a cross-sectional design. Heuberger and Caudell (2011) performed a cross-sectional study on community dwelling individuals over

65 years in the rural Midwest of United States to examine nutritional status, medication usage and drug nutrient interactions. Interviewer-administered surveys were used and 1065 were successfully completed. Nutritional status and physical health were assessed by using comprehensive questionnaires with food intake, food frequency, medical diagnosis, disability and use of health and social services. Correlations made with intake of macro- and micronutrients against physical health and number of medications, revealed that a higher number of medications used by older adults were associated with a poorer nutritional status and declining physical health. Although no nutritional assessment tools were used such as the MNA, but rather the actual food intakes and medical reports, greater strength is added to the claims of associated increased nutritional risk with polypharmacy. In fact, the MNA was used in another cross-sectional study by Janse et al (2013) at Gelderse Vallei Hospital in Netherlands over a 2 year period on 724 elderly persons visiting an out-patient clinic for the first time. The prevalence of polypharmacy ( $\geq 5$  drugs) was 66% and severe polypharmacy ( $\geq 10$  drugs) was as high as 24 %. Like the previous study above, even though a different method was used to assess malnutrition, polypharmacy was still found to be associated with more subjects in the lower MNA categories indicative of persons who are malnourished or at risk of malnutrition. To further substantiate the claim, a prospective cohort study conducted on individuals age 75 and older at a Geriatric based institution in Finland, using the MNA, reported that excessive polypharmacy (10+ drugs) are associated with declined nutritional status, functional ability and cognitive capacity when compared to a non-polypharmacy group (0-5 drugs) (Jyrkka et al, 2011). The study also found that in the excessive polypharmacy group, the proportion of malnourished or at risk of it increased from 31% to 50% over a 3 year duration; an actual change in nutrition, physical and cognitive function could not be predicted over the 3 year period.

Actual research regarding the relationship between polypharmacy and nutritional status were based more in the European and American countries. No research of this kind has been based in



the Caribbean, an area of rich culture and diversity. Furthermore, according to a literature review by Zadak et al (2013), the countries in Europe with the highest occurrence of polypharmacy include Czech Republic and Finland, whereas the lowest prevalence of polypharmacy is found in Norway and the Netherlands. There were variations however, among the studies, in the number of medications used to describe polypharmacy. The age group also varied and the range started from 65-75 years. Although this resulted in different values for prevalence of polypharmacy among the elderly, it still indicated that the prevalence of polypharmacy is high in the elderly, sufficient to merit future studies. The settings where the studies were based differed: hospital- in-patient and out-patient, rehabilitation, nursing home, community. This showed considerable difference in results among the studies with respect to the prevalence of malnutrition: rehabilitation, 50.5%; hospital, 38.7%; nursing home, 13.8% and community, 5.8%. (Kaiser et al 2010).

The tools used to assess nutritional status and give an early recognition of malnutrition all have their advantages and disadvantages. Whilst Poulia et al (2012) deduced that MUST seem to be the most valid tool in the evaluation of the risk for malnutrition in the elderly, it must be noted that this study was based in a hospital where the elderly, all over age 60 years, were admitted to the emergency department at the Clinic of Pathologic Physiology of Laikon General Hospital in Athens. So the tool may be best for the purpose for which it was designed; it has no parameters to assess functionality so clearly it was not designed with consideration for the elderly. On the other extreme, Cornel Seiber, (2006) deduced that the MNA, which was especially developed for elderly people, has remained the gold standard for nutritional screening in the elderly, as a matter of fact, Poulia et al (2012) stated that the MNA has been validated in all settings. Seiber, in his article, compared the strengths and weaknesses of the most commonly used assessment tools for malnutrition in the elderly and he found that although the NRS 2002 has very good potential in the acute-care setting, it was designed specifically for hospitalized patients who need nutritional

support. Sieber strongly supports the MNA as he reports that parameters such as weight changes, BMI and calf circumference are all sensitive signs for existing malnutrition and sarcopenia (a selective loss of muscle mass due to decreased physical activity or protein malnutrition) and these parameters are present in the MNA; he further states that sarcopenia becomes a problem when an individual's functionality and ability to perform daily activities are compromised so these parameters should be included in an assessment tool to increase its sensitivity and specificity. According to Sieber, a good tool should have parameters that test risks of functional problems, hospitalization and mortality. The MNA tool encompasses all of this but the MUST tool, even though it is quick and easy to perform, it does not assess functionality and it is too unspecific for an elderly population. The SGA tool has all the parameters like the MUST with a few extra to assess loss of muscle and fat mass, edema and ascites and for the acute disease, it focuses more on gastrointestinal problems. The disadvantage of the SGA tool is that it requires the assistance of a medical doctor to administer and thus its use is restricted. The MNA however, is very easy to perform in any setting; the screening takes about 5 minutes whilst the total assessment may take as long as 20 minutes. It includes additional parameters for food intake, functionality (mobility), dementia and depression and has been used in a multitude of both prospective and retrospective research. One of its disadvantages though, is that individuals with dementia may not be able to answer some of the questions on the assessment tool. The NRS 2002, although easy to perform as it does not include physical examination or anthropometry, it is not the best tool to be used in this study since it was not developed for the elderly population. However, Sieber reported that if the MNA cannot be performed, the best alternative would be the NRS 2002, especially in the acute-care setting where nutritional support is critical.

The following paragraph summarizes the significance of the study. Polypharmacy and malnutrition is very prevalent in the elderly and it has profound effects on their functionality and subsequently their state of health and quality of life. Many factors influence the nutritional status

of the elderly and this makes research in the area very difficult. Despite its prevalence and the usual changes that accompany ageing, malnutrition and polypharmacy are both preventable in the elderly. Furthermore, the ageing population is growing and yet only a few studies has been conducted on the topic. The relationship between polypharmacy and nutritional status has not yet been investigated in the Caribbean. Similar studies has been done in Michigan, Finland and Netherlands. No case-control study was done in examining the relationship between polypharmacy and nutritional status. These factors indicate the importance of conducting a study of this nature. Only with findings can we start interventions.

The hypothesis for this research is: polypharmacy users, age 65 years and more, are more likely to be malnourished or at risk of malnutrition.

The objective of the study is to determine whether there is a difference in nutritional status between polypharmacy and non-polypharmacy users who are  $\geq 65$  years.

## METHODOLOGY

This study is a case-control study, the proposal of which was approved by the Eric Williams Medical Sciences Complex (EWMSC) Ethics Committee. The study consisted of 103 elderly out-patient individuals who were accessed at EWMSC and it was conducted during November, 2013 to April, 2014.

The inclusion criteria were as follows:

- male or female adult greater than or equal to 65 years
- clinic attendee at EWMSC
- African, East Indian or Mixed (African and Indian only) descent.

The exclusion criteria were as follows:

- pregnant women
- persons under age 65 years
- persons with Alzheimer's disease
- persons with any mental disease or condition.

The study design is case-control.

The independent variable is polypharmacy status. Polypharmacy is defined as taking  $\geq 6$  concurrent medications. Non-polypharmacy is defined as taking  $< 6$  medications.

The dependent variable is nutritional status. The MNA tool was used to determine nutritional status. Persons with a score of  $\leq 23.5$  were considered malnourished or at risk of malnutrition.

Persons with a score of  $> 23.5$  were considered as having a normal nutritional status.

Persons who were polypharmacy were assigned as cases. Persons who were non-polypharmacy were assigned as controls.

Sample size was calculated using the formula:

$$n = pq / (SE)^2$$

where

n = sample size

p = proportion of the population possessing the major attribute expressed as a decimal (that is, the estimate of the expected prevalence of malnutrition among the elderly)

q = 1-p

SE = confidence level or standard error of the proportion

Calculation:

$$n = 0.34 \times 0.66 / 0.05^2 = 90$$

Thus required sample size is 90. However, 103 participants were used in the study.

0.34 is the proportion of community dwelling elderly people who are malnourished or at risk of it. This value was obtained from a literature review done by Jyrkka et al (2012) in which he summarized the evidence regarding polypharmacy and nutritional status in the elderly people.

To calculate the number of controls required, OpenEpi, Open Source Epidemiological Statistics for Public Health, was used. It is an open software for epidemiological statistics that can be run with or without a web server. The various values were entered in the sample size calculator for an unmatched case control study.

The output was as follows:

Two-sided confidence level (1-alpha) ....95

Power (% chance of detecting)..... 80

Ratio of Controls to Cases.... 1

Hypothetical proportion of controls with exposure 35

Hypothetical proportion of cases with exposure: 65.33

Least extreme Odds Ratio to be detected: 3.50

	Kelsey	Fleiss	Fleiss with CC
Sample Size - Cases	<b>43</b>	42	48
Sample Size - Controls	<b>43</b>	42	48
Total sample size	<b>86</b>	84	96

The bolded values were used as the minimum requirement: 43 cases, 43 controls

However, the actual study comprised of 57 cases and 46 controls.

The comparison group (non-polypharmacy) provides an estimate of the expected exposure (35%)

Participants were recruited from the out-patient pharmacy at EWMSO where interviewer administered questionnaires were completed (see appendix 1 for blank questionnaire). Patients who seemed to be 65 years or above were approached, introduced to the interviewer (myself) and then asked few questions to determine if they fit the criteria to be included in the study. If it was a prospective participant and he or she agreed to be enrolled in the study, then the nature of the study was explained, followed by a signing of a consent form (some participants gave verbal consent). This consent gave the interviewer permission to obtain and use the participant's private health information. The questionnaire was then administered to the participant and the following measurements were taken: weight, height, calf circumference and mid-arm circumference. Medication information was taken from the participant's prescription which was readily available for use at the pharmacy. At the end of the interview, the participant was given a pamphlet on healthy eating (see appendix 2) with emphasis that the information was general and that diet may be specific to one's medical ailment or condition. The length of each interview varied between 20 and 45 minutes.

Sampling was done over a period of 5 months, on different days of the week, in order to obtain participants from different clinics. It was mostly done during the morning period to increase participant's compliance. Attempts to work with the pharmacists to randomly select patients at

the outpatient pharmacy proved futile as it inconvenienced the pharmacists and it disrupted the working system at the pharmacy. As such, the interviewer did the selection based on visual judgement of age, gender and ethnicity.

For weight measurements, a portable scale was used and the interviewer always ensured it was positioned at zero before weighing. The participants were asked to remove any shoes/slippers and handbags before stepping on it; they were then directed to stand on the scale, face the interviewer, place hands at the sides and look straight ahead. Weight was then recorded in kilograms.

For height measurements, the participants were asked to keep the shoes/slippers off, stand against the wall with heels, shoulders and buttocks touching the wall, heels together, knees straight and hands at sides. They were directed to look straight ahead, then the interviewer tilted head up or down to align head in the Frankfort horizontal plane (that is, when the horizontal line from the ear canal to the lower border of the orbit of the eye is parallel to the floor and perpendicular to the wall). See appendix 4 for measurement of height. A clipboard was then placed on top of the participants head to touch the wall and then the position was marked off. The total length was measured with a steel measuring tape in centimetres. For non-compliant patients, the height was recorded from their National Identification card.

For mid-arm circumference measurements (see appendix 5), the participants were asked to stand facing away from the interviewer, non-dominant arm bent in an L (90 degree angle). The distance between the shoulder (bony protrusion) and the bony point of the elbow on the back of the arm was measured. The mid-point was then marked off with an eyeliner. The participants were then asked to allow the arm to hang loosely by the side. The measurement around the arm was then taken around the mid-point without compressing the skin in centimetres.

For calf circumference measurements (see appendix 6), the participants were given the option to stand with their weight evenly distributed or sit with their left leg hanging loosely. They were

then asked to roll up clothing on the left leg to reveal calf. The measurement was taken with a measuring tape around the widest part of the calf in centimetres.

Questionnaire:

The questionnaire consisted of 5 parts: demographic, medical, MNA, food frequency and lifestyle.

(See appendix 1 for copy of questionnaire).

The medical domain mainly seek information on the name of the medications that were being used by the participants; the actual drugs were recorded from the participants' prescription.

The MNA part consisted of the actual MNA that was incorporated in this questionnaire. It comprised of 18 question, each of which had a score. A total score was calculated and used to determine the nutritional status of the individual as follows:

24-30: normal nutritional status (30 is the maximum score)

17-23.5: at risk of malnutrition

Less than 17: malnourished

See appendix 3 for copy of MNA.

The food frequency section focused on consumption of sodas, salt, high fats and sugar and the lifestyle domain was based on exercise, smoking and alcohol intake.

After sampling, the data was entered into SPSS, Statistics Package for Social Science (version 20) for analysis. Descriptive analyses were used on the variables. T-tests analyses were done on the continuous variables such as age, number of persons in the household, number of ailments, weight, height and BMI to determine means scores and to see whether the mean scores differed significantly with polypharmacy and non-polypharmacy users. The chi-squared analyses were performed on the categorical data such as sex, ethnicity, education level, marital status, medical conditions, dietary and lifestyle variables, some anthropometric variables and the mini



assessment score and these were cross tabulated against polypharmacy and non-polypharmacy users to determine whether associations exists between them. This also yielded percentages and levels of significance (p values). If  $p < 0.05$ , then the association was significant.

## RESULTS

The questionnaires were administered to 103 participants. Those taking less than 6 medications were categorized as non-polypharmacy; persons taking 6 or more medications were categorized as polypharmacy. All variables were compared between polypharmacy users and non-polypharmacy users. The mean age of the polypharmacy users was 72.5 (5.9) and 74.2 (6.6) for the non-polypharmacy users. Other characteristics of participants by polypharmacy status are shown in Table 1. Persons with polypharmacy were more likely to have been diagnosed with diabetes (polypharmacy 70.2% vs non-polypharmacy 37%,  $p = 0.001$ ) and heart disease (polypharmacy 80.7% vs non-polypharmacy 30.4%,  $p < 0.001$ ). Participants were more likely to be of East Indian descent when compared to the African and Mixed ethnicities ( $p = 0.027$ ). There were no significant differences in age, gender distribution, education level and marital status between persons with polypharmacy and their non-polypharmacy counterparts.

Table 1. Characteristics of Participants by Polypharmacy Status

Variable	Non-polypharmacy n=46	Polypharmacy n=57	p-value
Age (years)	74.2 (6.6)	72.5 (5.9)	0.18
Sex (Female/Male)	25/21 (54.3/45.7%)	28/29 (49.1/50.9%)	0.69
Ethnicity			
East Indian	24 (52.2%)	43 (75.4)	0.027
African	13(28.3%)	8 (14.0%)	
Mixed	9 (19.6%)	6 (10.5%)	
Highest Education Level			
None	1 (2.2%)	2 (3.5%)	0.88
Primary	31 (67.4%)	38 (66.7%)	
Secondary	11 (23.9%)	11 (19.3%)	
Tertiary	3 (6.5%)	6 (10.5%)	
No. of persons in Household	3.8 (2.6)	3.04 (1.8)	0.11
Diabetes (yes)	17 (37%)	40 (70.2%)	0.001
Heart Disease (yes)	14 (30.4%)	46 (80.7%)	<0.001
High Blood Pressure (yes)	30 (65.2%)	42 (73.7%)	0.39
High Cholesterol (yes)	17 (37%)	31 (54.4%)	0.11
Arthritis (yes)	16 (34.8%)	29 (50.9%)	0.11
Marital Status			
Married	27 (58.7%)	35 (61.4%)	0.86
Single	7 (15.2%)	5 (8.8%)	
Divorced	2 (4.3%)	3 (5.3%)	
Widowed	10 (21.7%)	14 (24.5%)	

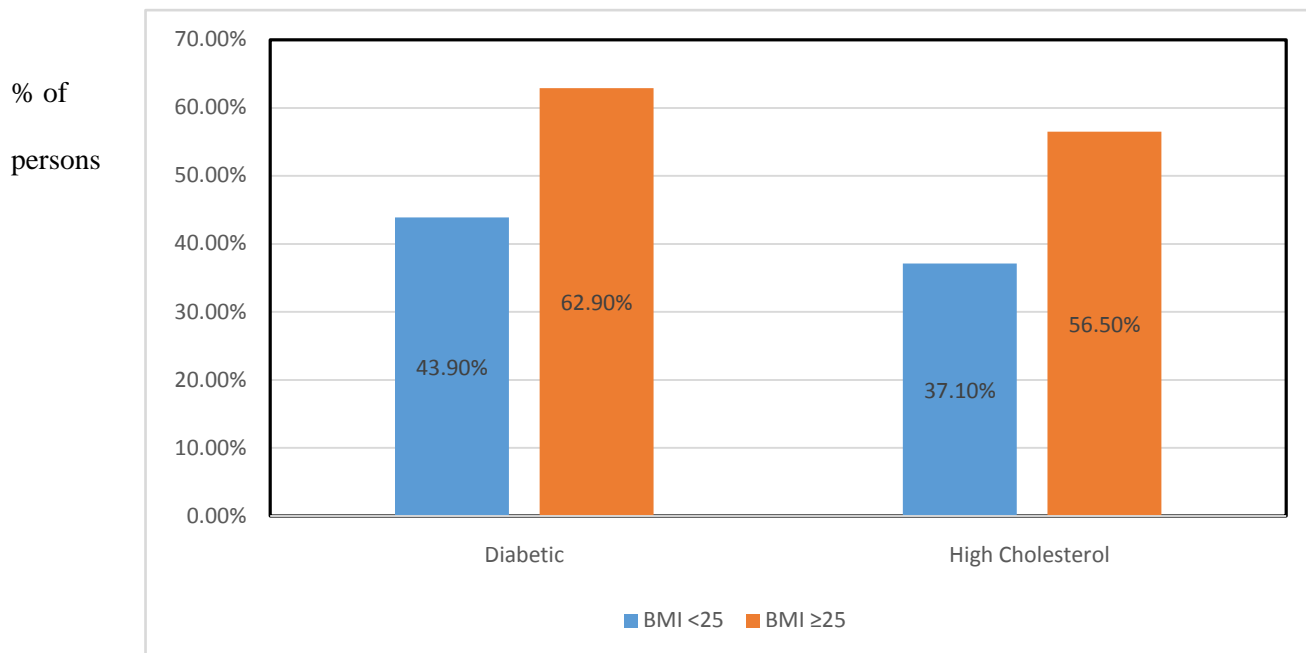
Table 2. summarizes the distribution of anthropometry, physical activity and dietary behaviour variables by polypharmacy status. It shows that persons with polypharmacy had significantly lower mini nutritional assessment (MNA) scores than their non-polypharmacy counterparts where p value was  $<0.001$ . The lower scores ( $\leq 23.5$ ) were indicative of either being malnourished or at risk of being malnourished whilst the higher scores ( $>23.5$ ) were indicative of a normal nutritional status. Individuals with polypharmacy were also significantly less likely to be involved in regular physical activity (polypharmacy 40.4% vs non-polypharmacy 60.9%,  $p = 0.05$ ). There were no significant difference in weight, height, body mass index (BMI), mid-arm circumference (MAC) and calf circumference (CC) between those who are polypharmacy and non-polypharmacy. Approximately quarter to one third of participants consumed high levels of fats, salted snacks and sodas on a weekly basis.

Table 2. Anthropometry, Physical Activity and Dietary Behaviour by Polypharmacy Status

Variable	Non-polypharmacy n=46	Polypharmacy n=57	p-value
Weight (kg)	69.1 (11.3)	72.6 (18.2)	0.26
Height (cm)	163.5 (7.2)	165.6 (9.7)	0.24
BMI (kg/m <sup>2</sup> )	25.8 (3.8)	26.7 (7.2)	0.47
BMI $\geq$ 25	60.90%	59.60%	
BMI $\geq$ 30	5 (10.9%)	9 (15.8%)	0.57
Mini Nutritional Assessment Score	27.0 (3.5)	24.3 (3.8)	<0.001
No. of Ailments	1.7 (1)	2.8 (1)	
Mid-Arm Circumference $\geq$ 22 cm	46 (100%)	55 (96.5%)	0.5
Calf Circumference $\geq$ 31 cm	45 (97.8 %)	54 (94.7%)	0.63
Exercise (yes)	28 (60.9%)	23 (40.4%)	0.05
High Fat Consumption > 12 times per week	10 (21.7%)	17 (29.8%)	0.38
Salted snack Consumption > 2 times per week	12 (26.1%)	20 (35.1%)	0.39
Soda Consumption > 2 times per week	18 (39.1%)	15 (26.3%)	0.20
Alcohol Consumption (yes)	13 (29.5%)	16 (28.1%)	0.87

Having a BMI  $\geq$ 25 (overweight) was associated with high serum cholesterol levels (56.5% vs 31.7%,  $p= 0.02$ ) and diabetes mellitus (62.9% vs 43.9%,  $p= 0.07$ ), however, the latter was not statistically significant (see Figure 1. Below)

Figure 1. Overweight Participants by Disease Status



The major findings of the study is shown in Figure 2. where it highlights the risks of malnutrition by polypharmacy status. Persons with polypharmacy were significantly more likely than their non-polypharmacy counterparts to be at increased risk for malnutrition (31.6% vs 13.0%,  $p=0.035$ ).

Figure 2. Risks of Malnutrition by Polypharmacy Status

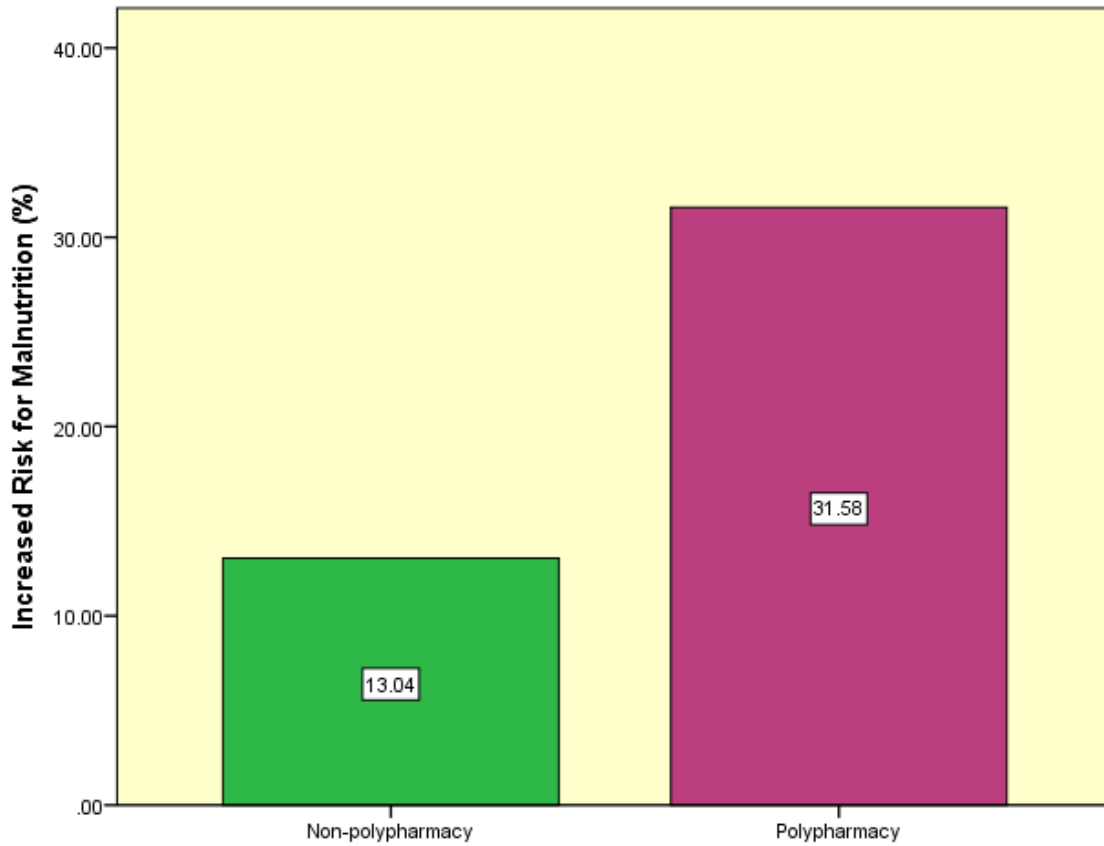
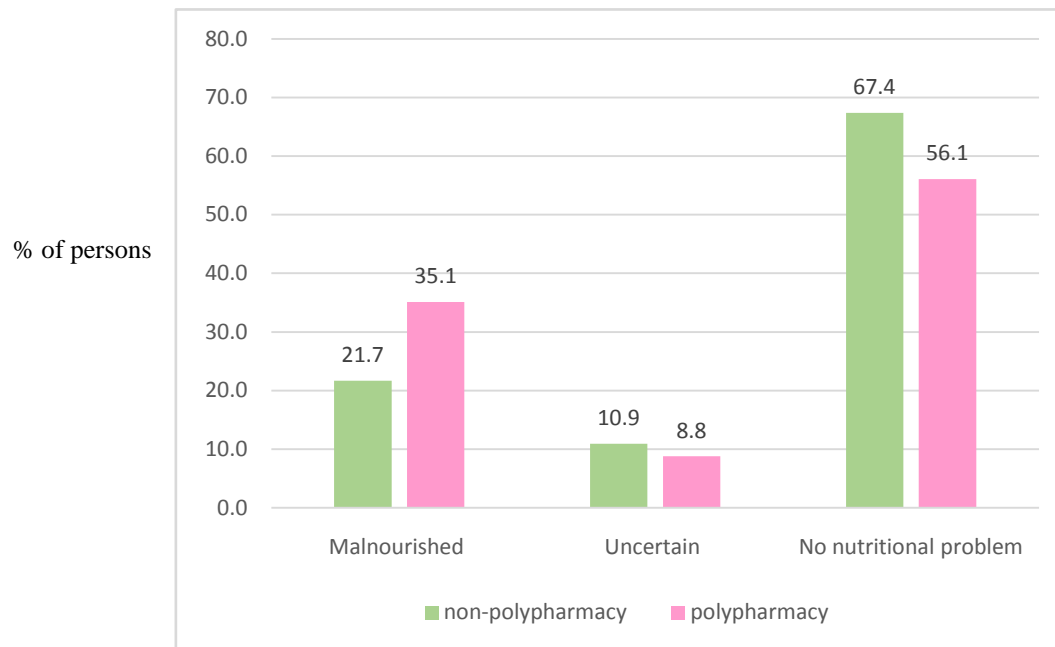


Figure 3. shows persons' beliefs about their nutritional status. The percentage of both polypharmacy and non-polypharmacy users who believed they had no nutritional problems (56.1% & 67.4%) were actually quite high as seen in Figure 3; the total percentage of individuals who viewed themselves as having no nutritional problems was 61.2%.

Figure 3. Show Self-View of Nutritional Status by Polypharmacy Status



The study also found that 68% of persons believed that their health status were better than other persons of the same age.



## DISCUSSION

Questionnaires were used on the elderly persons to assess their nutritional status and to determine whether the polypharmacy users are more likely to be malnourished or at risk of it than their non-polypharmacy counterparts. Analyses revealed that significant associations occur between polypharmacy and non-polypharmacy users.

The study found that the nutritional status are adversely affected in the elderly who are taking 6 or more medications. These findings were consistent with other similar studies that were conducted. Heuberger & Caudell (2011) used actual food intake, a more accurate measurement, as oppose to the MNA tool used in this study, and they found that polypharmacy did in fact, had an adverse effect on macro- and micronutrients. They did not clearly define polypharmacy but they did state that major polypharmacy referred to the intake of 5 or more medications. Never the less, the findings were similar. Jyrkka et al (2011) showed similar findings with a further decline in functional ability and cognitive capacity but by excessive polypharmacy ( $\geq 10$  drugs) in patients who are  $\geq 75$  years. They utilized two additional tools IDAL (Instrumental activities of daily living) and MMSE (Mini-mental status examination), to examine these factors but the MNA only had three parameters for cognitive ability. Assessing functional and cognitive factors are pertinent in determining malnutrition. Polypharmacy increases adverse drug reactions, side effects of medications and a subsequent altered food intake and nutrient utilization in the elderly placing persons at greater risk of malnutrition.

A higher prevalence of polypharmacy was seen in East Indian descent than the African or Indo-African descent. The method of sampling was not totally random and may have selection bias, however, there were a greater number of East Indians at the out-patient pharmacy on a daily basis. Other studies were based on Americans or Europeans so there are no literature to compare these findings. It is assumed the types and amount of food eaten by the East Indians such as rice, roti and fats are greatly influenced by their culture however, more research is needed in this area.

These high fats and carbohydrate diets may lead to chronic diseases which will expose these persons to multiple medications and thus greater risk of polypharmacy and again, altered nutritional status.

Chronic diseases predisposes the elderly to polypharmacy. The current study supports this claim for diabetes, cardiac diseases, high blood pressure and high serum cholesterol levels although only the diabetes and cardiac disease were significantly different between the polypharmacy and non-polypharmacy groups. The majority of all the participants (69.9%) had high blood pressure accounting for no variations between the groups. A pharmacy update done by Austin, (2006) states that dyslipidaemia and high blood pressure are two of the comorbidities of diabetes along with heart disease which also accompanies it; each of these condition often require one or more drugs for treatment. This increases the risk for polypharmacy if not managed properly with adequate nutritional advice.

Generally, for adults  $\geq 18$  years, an increased BMI is associated with a higher risk for metabolic diseases such as diabetes, dyslipidaemia and high blood pressure and for each condition, more than three quarters of the sampled population were overweight (Bays et al, 2007). These findings were reflected in this study with respect to diabetes and high serum cholesterol only. This association may be implicated by adipose tissue diseases and possibly enhanced by a sedentary lifestyle.

A greater percentage of non-polypharmacy users were involved in exercise compared to their polypharmacy counterparts in this study and the findings were significant. Persons who exercise may have a lower risk for chronic diseases and thus a lower intake of medications.

This study had quite a number of limitations. Firstly, the sampling was not totally randomized and would have a certain amount of bias by the interviewer. There were also more participants in the study from certain clinics at EWMSC compared to others; patients who required many medications tend to access the outpatient pharmacy more often compared to those who required

fewer and less expensive drugs. Even if one or two drugs were required, those persons spent a very short time in the out-patient pharmacy and as such were very difficult to approach. Attempts were made to access patients at the various clinics to further randomize sampling, however, this was very difficult and inconveniencing due to the working system at the clinics. Height measurements were sometimes taken from the individuals' National Identification card when it was either very difficult or when they were hesitant to take the proper measurements. Weight measurements were at times taken without removing shoes/slippers, again this occurred when it was difficult or tedious for the individuals. These measurements would have affected BMI values, a major parameter in the MNA assessment tool. Due to time limitations the values for calf circumference or mid-arm circumference were not recorded but rather only indicated on the questionnaire according to the categorized ranges. This restricted the usefulness of the data collected. The design of the study and the large number of cofounders for malnutrition does not allow for the determination of a cause and effect relationship but rather associations only. In fact, this type of study was designed to help determine if an exposure (polypharmacy in this instance) is associated with an outcome (malnutrition).

It is recommended that a more random sample be obtained and from a greater variety of clinics. Also too, since no study of this type has ever been done in the Caribbean, it is suggested that more research be conducted in the topic to encompass our diversity in culture, ethnicity and eating habits so that appropriate interventions can be made to match our population.

## CONCLUSION

Among individuals age 65 and over, there is a difference in nutritional status between the polypharmacy and non-polypharmacy users. The polypharmacy users were more likely to be malnourished or at risk of it than their non-polypharmacy counterparts.

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**Appendix 1- Questionnaire**

**QUESTIONNAIRE  
POLYPHARMACY AND NUTRITION**

I am a student at the University of The West Indies and I would like to conduct a study on the use of your medication, your nutritional status, and your eating and lifestyle habits. Your participation is voluntary. The information collected will remain confidential and the data will only be used for research purposes under the supervision of Dr. Selby Nichols, a senior lecturer at The University of The West Indies. It is very important for you to answer all the questions to the best of your knowledge. Thank you for your participation.

**Date:**

**DEMOGRAPHICS**

Patient Name _____	Contact Number _____	
Age _____	Gender _____	Ethnicity _____
Marital Status _____	Weight _____	Height _____
Highest Educational level _____		
Number of persons in household _____		

**MEDICAL INFORMATION**

**1) What disease(s) are you diagnosed with?**

- a. Diabetes (Sugar)
- b. Heart disease
- c. High blood pressure
- d. High cholesterol (Hypercholesterolemia)
- e. Arthritis

**2) What Clinic(s) do you attend at the EWMSC?**

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**3) List of Medications that are prescribed to the participant** (the interviewer will obtain this information from the submitted prescription)

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**4) Participant’s compliance to prescribed medication**

How often do you take the exact amount of medications prescribed?

- a. Always
- b. Often
- c. Sometimes
- d. Rarely
- e. Never

How often do you take your medication on time?

- a. Always
- b. Often
- c. Sometimes
- d. Rarely
- e. Never

**5) What other medications do you take besides what is listed in your prescription? Please state quantity**

Over the counter medications:

Supplements:

6) Are you being treated for the same disease at more than one health facility?  Yes  No

**7) Mini Nutritional Assessment (MNA)**

**A. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?**

- 0 = severe decrease in food intake
- 1 = moderate decrease in food intake
- 2 = no decrease in food intake

**B. Weight loss during the last 3 months**

- 0 = weight loss greater than 3 kg (6.6 lbs)
- 1 = does not know
- 2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
- 3 = no weight loss

**C. Mobility**

- 0 = bed or chair bound
- 1 = able to get out of bed/chair but does not go out
- 2 = goes out

**D. Has suffered psychological stress or acute disease in the past 3 months**

- 0 = yes
- 2 = no

**E. Neuropsychological problems**

- 0 = severe dementia or depression
- 1 = mild dementia
- 2 = no psychological problems



**F. Body Mass Index (BMI) – weight in kg/ height in m<sup>2</sup>**

0 = BMI less than 19

1 = BMI 19 to less than 21

2 = BMI 21 to less than 23

3 = BMI 23 or greater

**G. Lives independently (not nursing home or hospital)**

1 = yes

0 = no

**H. Takes more than 3 prescription drugs per day**

0 = yes

1 = no

**I. Pressure sores or skin ulcers**

0 = yes

1 = no

**J. How many full meals does the patient eat daily?**

0 = 1 meal

1 = 2 meals

2 = 3 meals

**K. Selected consumption markers for protein intake**

- At least one serving of dairy products (milk, cheese, yogurt) per day
- Two or more servings of legumes or eggs per week
- Meat, fish or poultry every day

 Yes

 No

 Yes

 No

 Yes

 No

0.0= if 0 or 1 yes

0.5 = if 2 yes

1.0 = if 3 yes

. 

**L. Consumes two or more servings of fruit or vegetables per day?**

0 = no

1 = yes

**M. How much fluid (water, juice, coffee, tea, milk...) is consumed per day?**

0.0=less than 3 cups

0.5 = 3-5 cups

1.0 = more than 5 cups

. 

**N. Mode of feeding**

0 = unable to eat without assistance

1 = self-fed with some difficulty

2 = self-fed without any problem

**O. Self view of nutritional status**

0 = view self as being malnourished

1 = is uncertain of nutritional state

2 = views self as having no nutritional problem

**P. In comparison with other people of the same age, how does the patient consider his/her health status?**

- 0.0 = not as good
- 0.5 = does not know
- 1.0 = as good
- 2.0 = better

.

**Q. Mid-arm circumference (MAC) in cm**

- 0.0 = MAC less than 21
- 0.5 = MAC 21 to 22
- 1.0 = MAC 22 or greater

.

**R. Calf circumference (CC) in cm**

- 0 = CC less than 31
- 1 = CC 31 or greater

Total Assessment Score:  .  .

**Malnutrition Indicator Score:**

Total maximum score = 30

17 to 23.5 points                      at risk of malnutrition

Less than 17 points                      malnourished

Greater than 23.5 points              Normal

<b>FOOD FREQUENCY</b>		<b>8. How often , on average, do you eat any of th following foods?</b>						
	Never	Once a month	2-3 times a month	Once a week	2-3 times a week	4-6 times a week	Everyday	Other
<b>8a. Fats and oils</b>								
1.Butter/margarine/golden ray		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Salad dressing/Mayonnaise		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>8b. Salty Snacks</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>8c. Foods high in sugar &amp; fats</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eg. Pastries, chocolates, ice-creams, donuts, fried foods								
<b>8d. Soft drinks/sodas</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**LIFESTYLE**

9) Do you smoke?  Yes  No

10) How often do you smoke?

- a. Once per month
- b. once per week
- c. 2-3 times per week
- d. 4-6 times per week
- e. everyday
- f. other

11) How many cigarettes do you smoke each time? \_\_\_\_\_

12) Do you exercise? Specify type eg walk  Yes  No

13a) How often do you exercise?

- a. Once per month
- b. Once per week
- c. 2-3 days per week
- d. 4-6 days per week
- e. Everyday
- f. other (specify) \_\_\_\_\_

13b) How long do you exercise each time?

- a. <10 mins
- b. 10-20mins
- c. 21-30 mins
- d. 31- 45 mins
- e. Other (please specify) \_\_\_\_\_

14) Do you drink alcohol?  Yes  No

15) How often do you drink alcohol?

- a. Once per month
- b. Once per week
- c. 2-3 days per week
- d. 4-6 days per week
- e. Everyday
- f. Other (please specify) \_\_\_\_\_

**Thank you for your participation!**

**Appendix 2- Pamphlet on Healthy Eating**

EATING HEALTHY OVER 60

*Those who do not find time for exercise & diet will have to find time for illness!*

TIPS FOR HEALTHY LIVING

Small meals frequently

Smart snacks between meals eg. yo-  
gurt vs ice-cream

Go for variety & moderation!

Adequate calcium for bone health

8-10 glasses of water every day.

Exercise regularly.

You are never too old to exercise!



REMEMBER:

**ENJOY YOUR MEALTIMES!**

**EAT WITH COMPANY!**



*Let food be your medicine*

TIPS TO HEALTHY AGING:

**Eat healthy**

**Exercise regularly**

**Get involved in activities you enjoy**

**Stay connected with people**

I am more than 60. Why eat healthy?

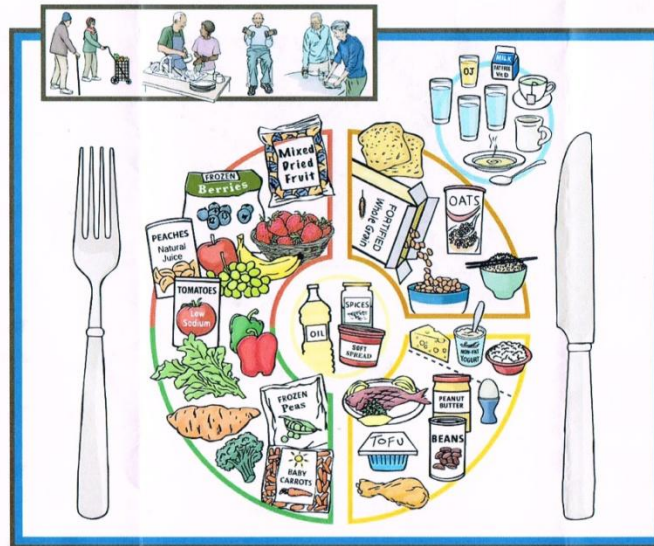


- To live longer & stronger
- To have more energy
- To sharpen the mind
- To take better control of my ailments
- To feel better!
- To look better!



**I am over 60. How do I feel like 40?**

**MyPlate for Older Adults**



**EAT**

**Plenty fruits and vegetables**

Melons, apples, pawpaw, mangoes

**Low fat**

Olive oil, coconut oil, avocados, salmon, walnuts, flaxseed

**High protein**

Peas, beans, fish, eggs, milk, cheese, nuts

**Rich Fibre**

Fruits & vegetables, whole grains, beans

**Remember!**

Your diet depends on your medical ailment

**OVERCOMING OBSTACLES**

**Loss of appetite**—boost appetite with olive oil, vinegar, garlic, onions, ginger, spices

**Difficulty chewing**— make smoothies with fresh fruits, yogurt, protein powder. Eat soft foods

**Dry mouth**— drink 8-10 glasses of water a day. Add sauces to food. Avoid mouthwash

**Don't like healthy food**— keep an open mind and start with small steps eg include fruit or veggie at each meal

**He that takes medicine & neglects diet  
Wastes the skills of the physician**



**Appendix 3 – Mini Nutritional Assessment (MNA) - Full Form**



Mini Nutritional Assessment  
MNA®

Last name: \_\_\_\_\_ First name: \_\_\_\_\_ Sex: \_\_\_\_\_ Date: \_\_\_\_\_

Age: \_\_\_\_\_ Weight, kg: \_\_\_\_\_ Height, cm: \_\_\_\_\_ I.D. Number: \_\_\_\_\_

Complete the screen by filling in the boxes with the appropriate numbers.  
Add the numbers for the screen. If score is 11 or less, continue with the assessment to gain a Malnutrition Indicator Score.

**Screening**

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?  
0 = severe loss of appetite  
1 = moderate loss of appetite  
2 = no loss of appetite

B Weight loss during the last 3 months  
0 = weight loss greater than 3 kg (6.6 lbs)  
1 = does not know  
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)  
3 = no weight loss

C Mobility  
0 = bed or chair bound  
1 = able to get out of bed/chair but does not go out  
2 = goes out

D Has suffered psychological stress or acute disease in the past 3 months  
0 = yes 2 = no

E Neuropsychological problems  
0 = severe dementia or depression  
1 = mild dementia  
2 = no psychological problems

F Body Mass Index (BMI) (weight in kg) / (height in m<sup>2</sup>)  
0 = BMI less than 19  
1 = BMI 19 to less than 21  
2 = BMI 21 to less than 23  
3 = BMI 23 or greater

Screening score (subtotal max. 14 points)    
12 points or greater Normal – not at risk – no need to complete assessment  
11 points or below Possible malnutrition – continue assessment

**Assessment**

G Lives independently (not in a nursing home or hospital)  
0 = no 1 = yes

H Takes more than 3 prescription drugs per day  
0 = yes 1 = no

I Pressure sores or skin ulcers  
0 = yes 1 = no

Ref. Vellas B, Villars H, Abellan G, et al. Overview of the MNA® - Its History and Challenges. J Nutr Health Aging 2006;10:455-465.  
Rubenstein LZ, Hanker JO, Salva A, Guigoz Y, Vellas B. Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF). J Geront 2001;56A:M366-377.  
Guigoz Y. The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us? J Nutr Health Aging 2006;10:466-487.

© Nestlé, 1994, Revision 2006. N67200 12/99 10M  
For more information : www.mna-elderly.com

J How many full meals does the patient eat daily?  
0 = 1 meal  
1 = 2 meals  
2 = 3 meals

K Selected consumption markers for protein intake  
• At least one serving of dairy products (milk, cheese, yogurt) per day yes  no   
• Two or more servings of legumes or eggs per week yes  no   
• Meat, fish or poultry every day yes  no   
0.0 = if 0 or 1 yes  
0.5 = if 2 yes  
1.0 = if 3 yes

L Consumes two or more servings of fruits or vegetables per day?  
0 = no 1 = yes

M How much fluid (water, juice, coffee, tea, milk...) is consumed per day?  
0.0 = less than 3 cups  
0.5 = 3 to 5 cups  
1.0 = more than 5 cups

N Mode of feeding  
0 = unable to eat without assistance  
1 = self-fed with some difficulty  
2 = self-fed without any problem

O Self view of nutritional status  
0 = views self as being malnourished  
1 = is uncertain of nutritional state  
2 = views self as having no nutritional problem

P In comparison with other people of the same age, how does the patient consider his/her health status?  
0.0 = not as good  
0.5 = does not know  
1.0 = as good  
2.0 = better

Q Mid-arm circumference (MAC) in cm  
0.0 = MAC less than 21  
0.5 = MAC 21 to 22  
1.0 = MAC 22 or greater

R Calf circumference (CC) in cm  
0 = CC less than 31 1 = CC 31 or greater

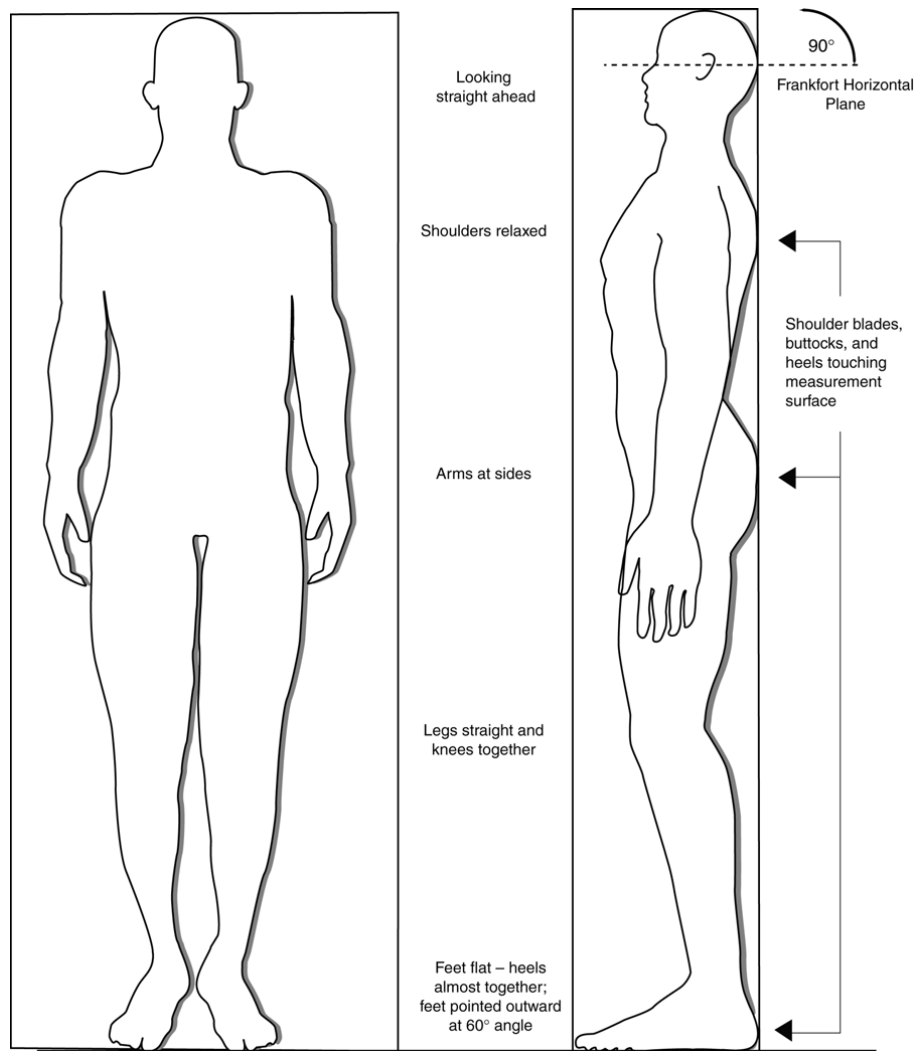
Assessment (max. 16 points)

Screening score

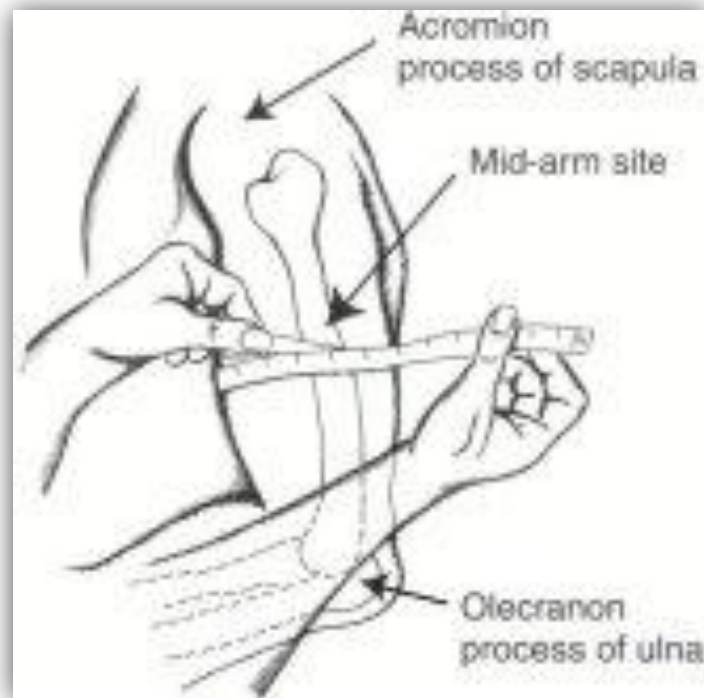
Total Assessment (max. 30 points)

Malnutrition Indicator Score  
17 to 23.5 points at risk of malnutrition   
Less than 17 points malnourished

**Appendix 4 – Measurement of Height in the Frankfort Horizontal Plane**



### Appendix 5 –Measurement of Mid-Arm Circumference





**Appendix 6 – Measurement of Calf Circumference**