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Health Care Utilization among Elderly according to Body Mass Index and risk of Malnutrition

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Abstract

Background: Malnutrition is prevalent among elderly, and this trend is projected to continue due increased life expectancy and more so, malnutrition has been attributed to morbidity and mortality. Further, investigations reveal that malnutrition is associated with prolonged hospital stay, use of emergency services and long term care services. The association between health care utilization and malnutrition will be explored in this study.

Method: The study material was collected from the Tromsø 6 cross-sectional study. The study population is comprised of 4017 elderly women (53.5%) and men (46.5 %) aged ≥65 years. The assessment of malnutrition was effectuated by using the body mass index (BMI) and the Malnutrition Universal Screening Tool (MUST). The BMI was classified in to six categories, while the MUST derived three MUST score categories 0, 1, and 2+. The score 1 and 2+ indicated medium and high risk respectively. While taking into consideration some socio-economic and demographic variables, the exploration of the association between health care utilization (visit to GP or medical specialist last year or surgery the last three years) and nutritional assessment variables was accomplished using cross tabulation, analysis of variance (ANOVA) and logistic regression.

Results: The respondents in the higher BMI categories were most likely to visit the GP, but no relationships were found between BMI and use of medical specialist or surgery during the last three years. Inconsistent associations were seen regarding risk of malnutrition and GP consultations, but there were indications that increased risk of malnutrition was associated with higher odds of surgery during the last three years and visit to the medical specialist last year.

Discussion: The results suggest that BMI and MUST score is related to selected indicators of health care utilization, but in different directions. The cross-sectional design of the study limits the possibility for conclusions regarding causality. The results may also suggest that

elderly subjects at high risk for malnutrition do not get sufficient attention in the primary health care.

Search words: elderly, malnutrition, health care utilization, BMI, MUST

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Introduction

The number of elderly citizens are said to be on the rise and this is being considered a global issue, which is projected to continue as a result of an increase in life expectancy [1, 2]. The predictors of this trend include declining fertility rates, reduced infant and child mortality rates which are also indications of the number of surviving children. More so, there are reports of people living longer due to medical advances, health care, sanitation, nutrition, education and the economic well-being [3].

After 2015, the number of individuals aged sixty and above will increase greatly in over half of the world`s countries. Thereof, countries will experience the most important change in population structure [1].

Moreover, as a result of the demographic change, the wellbeing and health of the elderly population is receiving greater attention [2]. This includes health issues such as nutritional status which tends to decline due physiological, psychological, economic and social factors [4, 5]. Further, studies have shown that malnutrition results in the elevation of mortality rates [6, 7], vulnerability to infections, life quality impairment [7, 8], and it is also associated to mental health reduction [7, 9], as well as a variety of chronic health conditions [10]. Similarly, the negative health outcomes resulting from malnutrition have been associated with the increased use of health resources [5]. This is, however, an undesired outcome for our society which currently, strives to reduce health care costs through the implementation of health reforms, research promotion and health awareness programs.

1.1. Health care utilization among the elderly

It is well-established that the prevalence of diseases such as depression, cancer, and heart diseases increase with age and elderly people often have co-existent medical conditions [7]. Thus health care utilization increases with age especially among women [11, 12]. Further, health care utilization varies among the elderly. Those above 80 years seem to consult the GP and the emergency unit more frequently as opposed to their younger counterparts between the ages 65 and 69 years. However, the frequency of GP visits have a tendency to decrease after about 85 years, which can be related to institutionalization, the use of informal care, well-established routines or losing long-lasting contact with GP [12].

1.2. Malnutrition in the community

Malnutrition can be defined as a state of deficiency, imbalance or excess of proteins, energy and other nutrients which cause adverse health and psychosocial outcomes [13, 14]. For example, it has been shown that undernutrition assessed by the MAG tool (which combines information about body mass index and unintentional weightloss) was associated with low serum levels of vitamin A,D,E, C and Zink [15].

However, while overnutrition poses a serious health threat in the younger population, undernutrition, the main focus in this study, on the other hand, is associated with morbidity and mortality in the elderly population [14]. The prevalence of undernutrition is high in institutionalized patients [16-19], as well as in the community where it most probably originates. Malnutrition has been observed among patients admitted to hospital likewise those admitted to care homes from their own homes [5, 20, 21], more so, a majority of these patients were at high risk [20]. The demographic structure changes, so would the prevalence

of malnutrition rise because of age association with frailty and frail adults are susceptible to undernutrition.

1.3. Risk factors associated with malnutrition in the elderly

Several known factors, or a combination of them, increase an individual`s vulnerability to malnutrition. Among these factors are; older age, depression [7, 22], poor cognitive function [22], chewing and biting difficulties [5, 22], dementia, co-morbidities, multiple medications (19-20), poor appetite, vision problems and stress [22] . These health issues are more rampant in the elderly thus the increased prevalence of malnutrition [7]. Furthermore, elderly living in care homes, hospitalized, disabled, socially isolated, as well as those with low income are particularly prone to malnutrition [13, 19].

1.4. Use of health care and malnutrition

Besides its physical and psychosocial effects on patients, malnutrition exerts a significant burden on health and social resources. For instance, the frequency of GP visits among those diagnosed with malnutrition was twice that of the non-malnourished. More so, they had three times more hospital admissions and a considerable longer of stay in hospital [13]. Further, a retrospective cohort study examining health care usage and mortality in underweight older adults revealed that the mortality and number of visits to the emergency unit was higher in the underweight sample as compared to the normal and obese subjects [23]. In addition, utilization of long term residential care or nursing services rise considerably due to malnutrition [24]. As regards the obese population, evidence reveals higher chances of hospitalization and mortality as compared to those with normal weight primarily due to higher risk of chronic disorders such as metabolic syndrome, diabetes, stroke and cancer [25].

1.5. Measures of malnutrition

Body Mass Index (BMI)

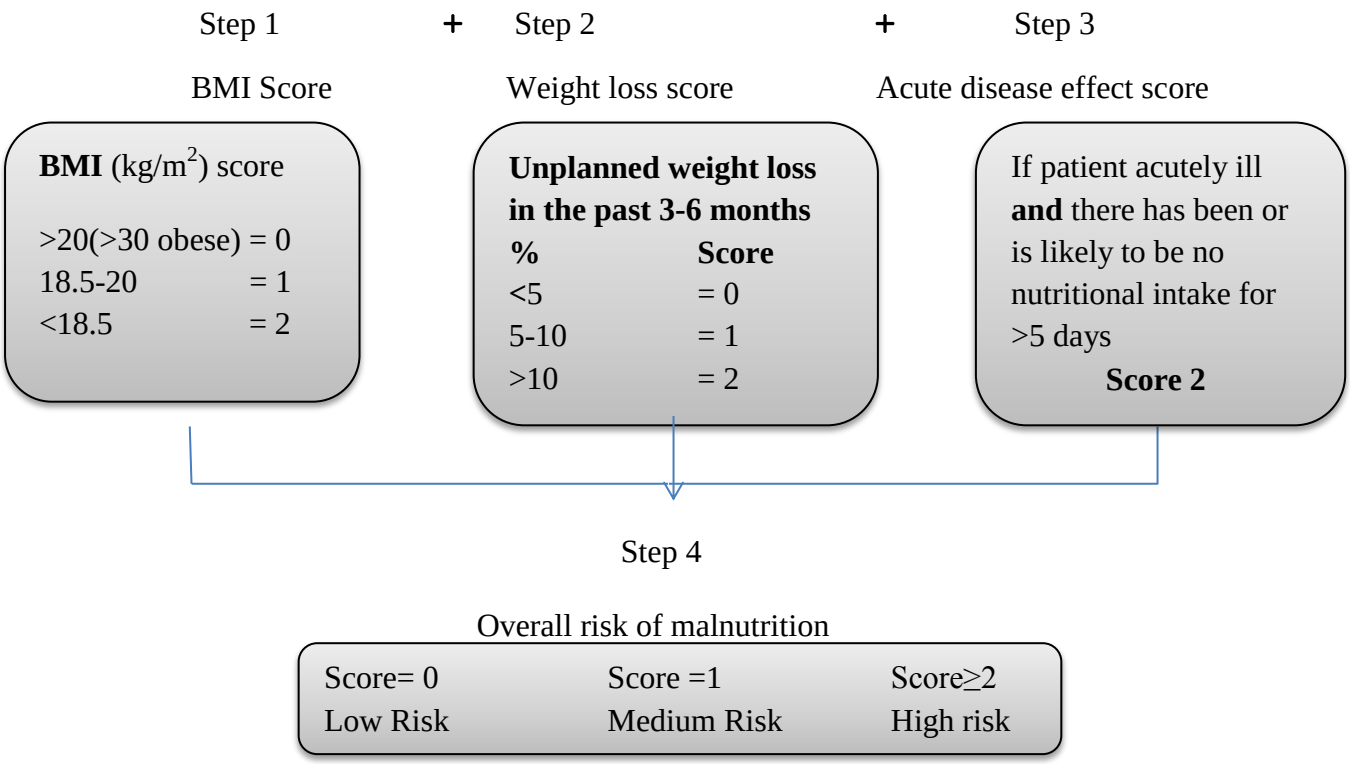
Nutritional status assessment in the elderly can be based on biochemical measurement, anthropometric measurements and clinical assessment although their reliability in the assessment of malnutrition is controversial due to accuracy related issues. However, body mass index (weight [kg]/ height [m^2]) [14] is frequently used since it is an easy and less time-consuming method of measuring nutritional status. More so, BMI predicts disease risk in those assessed as underweight or overweight. The World Health Organization (WHO) categorizes underweight as BMI < 18.5, normal 18.5-24.9, overweight as 25-29.9 and obese 30-39.9 and extreme obesity > 40 [26].

On the other hand, the use of BMI in the elderly population could be a source of error since the body composition is inappropriately measured due to the fact that relative fat mass increases with age, that is a younger person with a given BMI will have less adipose tissues compared to an elderly individual with the same BMI value [10]. However, although WHO has set a BMI cut-off point for low BMI at 18.5 kg/ m^2 for all adults, the necessary cut off points for different ages was also considered, but there isn`t any consensus on that yet. Most screening tools use BMI cutoff values 18.5-20 kg/m^2 in order to differentiate underweight adults from the non-underweight adults. Since these cut-off points will influence the prevalence of malnutrition, establishing cut-off points which take into account vital factors such as presence or absence of disease, ethnicity and gender will be optimal. It has nonetheless been a challenging task to establish these cut-off points [26].

The Malnutrition Universal Screening Tool (MUST)

MUST is one of many tools utilized in the screening for malnutrition. The MUST tool was developed by the British Association for Parenteral Nutrition (BAPEN) in 2003, and designed to screen patients for the risk of malnutrition in all care settings. The tool execution was intended to be easy in order to detect those at risk of malnutrition and the malnourished [20]. It comprises three items body mass index (BMI), weight loss effect and acute disease effect (Figure 1). When used among hospitalized subjects, MUST predicts length of hospital stay and mortality in elderly wards while in the community, it predicts rates of hospital admission and GP visits [27].

Figure 1 The Malnutrition Universal Screening Tool (MUST)



(Malnutrition Universal Screening Tool is reproduced with the kind permission of BAPEN, see www.bapen.org.uk)

2. Objectives of the study

Health care utilization studies have focused on the association between underweight or BMI and health care utilization in the elderly [23, 25, 28, 29], but to the best of our knowledge, no other study has actually explored health care utilization in community dwelling elderly using both BMI and risk of malnutrition in a community setting .

The aim of my thesis is to investigate the association between the level/pattern of health service utilization and the risk of malnutrition in community dwelling elderly ≥ 65 years.

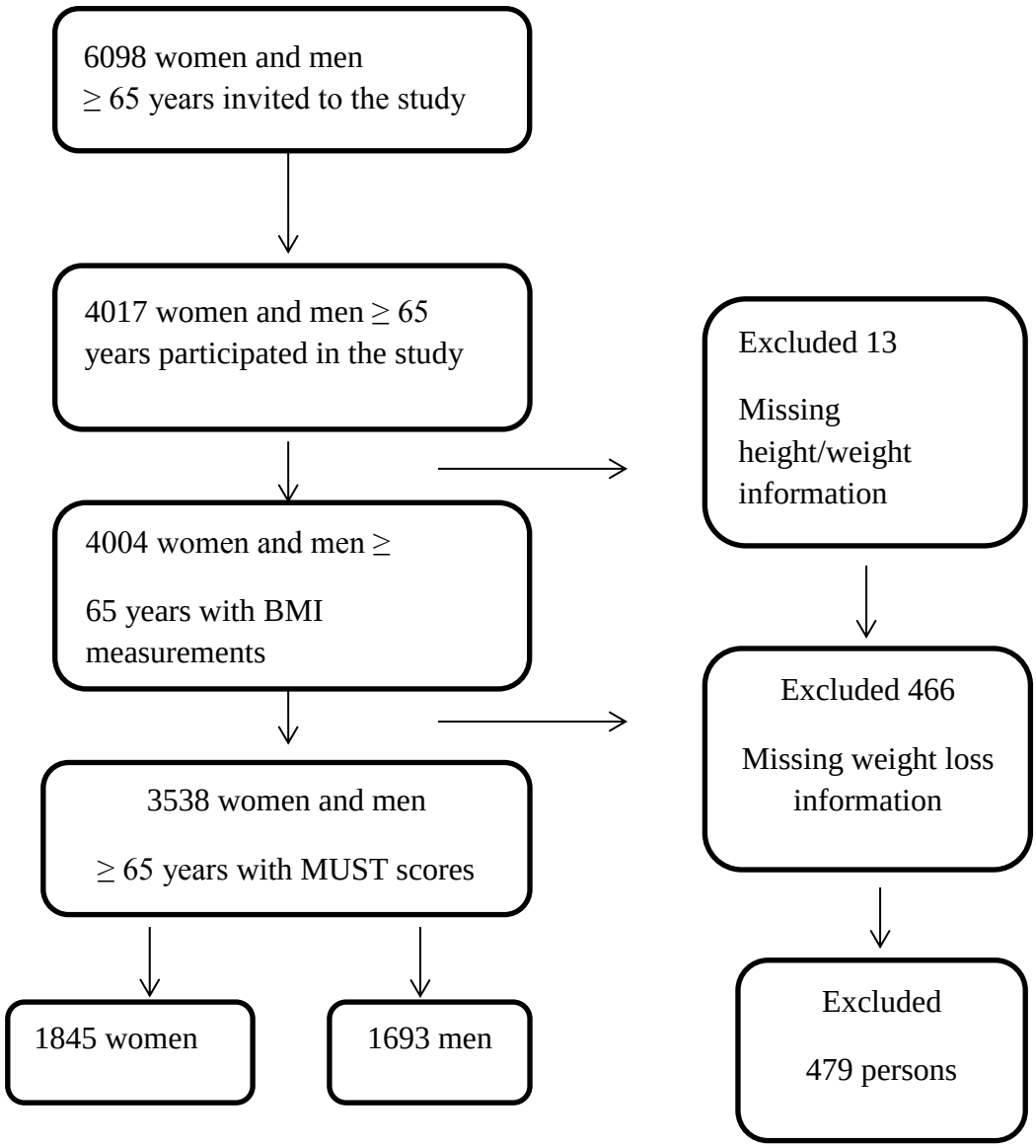
I will also investigate if there are any gender differences in health care consumption among elderly citizens with nutritional issues.

2.1. Research Question

In gender specific analyses, how does the frequency of GP and medical specialist visits in the previous year as well as surgery in the three previous year correlate with risk of malnutrition assessed with the MUST tool and BMI values?

Could the possible relationships between risk of malnutrition and health care utilization be explained by marital status, support from friends, participation in social activities and educational level?

Figure 2 Flow chart of the study population



3. Method

3.1. Study population

The data was collected from the Tromsø 6 cross-sectional survey. Tromsø is a city in the North of Norway with about sixty-five thousand inhabitants, predominately ethnic Norwegians. Invited to the Tromsø 6 study in October 2007 were all residents of the Tromsø municipality aged 40-42 years, and 60-87 years alongside a 10% random sample as of inhabitants between 30-39 years and 40 % random sample aged 43-59 years. In addition, participants of the second visit of the Tromsø 4 carried out about twelve years earlier were also invited [30].

A total of 6,098 women and men aged between 65-87 years received invitations, 4,017 subjects (66%) participated in the survey. Among these were 1867 men and 2150 women, which make up the study population (Figure 2). Kvamme et al. have shown that the attendance rate (the proportion of the invited population who attended the screening) was 78%, 68%, 40% in women aged 65-69, 70-79, and 80-87, respectively. The corresponding figures in men were 78%, 70 %, 40%, respectively [31].

All invited subjects received an information brochure, and a four paged questionnaire together with the invitation. The questionnaire comprised among others of questions about general health, medications, health service usage, socioeconomic situation, physical activity, leisure time activities and other life style habits. The subjects were asked to bring along the self-administered questionnaires on the day of the physical examination. Any uncertainties regarding the questions were presented to the staff at the examination center for clarification.

At the research center, all respondents underwent physical examinations which entailed anthropometric measurements such as body weight and height. A second questionnaire was handed out to the attendees at the research center on the day of the physical examination. The data included in the present analyses was collected from the physical examinations and the two self- administered questionnaires. The relevant pages of the questionnaire are included in the Appendix.

3.2. Variables

3.2.1. Independent variables

- **Body mass index (BMI)**

Participants wore light clothing and no shoes during the measurement session. The height was measured in cm and body weight in kg to the nearest decimal using a Jenix DS-102 stadiometer (Dong Sahn Jenix Co., Ltd. Seoul, Korea).

In order to obtain the BMI value, the weight was divided by the square of height (kg/ m^2). Then, BMI was classified in to six categories (≤19 kg/ m^2**,** 20-22.4 kg/ m^2**,** 22.5-24.9 kg/ m^2**,** 25-27.49 kg/ m^2**,** 27.5-29.9 kg/ m^2 and ≥ 30 kg/ m^2). BMI for 13 subjects were missing, so these were excluded from all analyses (Table 1).

- **MUST score**

Malnutrition Universal Screening tool (MUST) was used in the identification of subjects at risk of malnutrition [32]. MUST score was a sum of the BMI score and the weight-loss score. The acute disease effect score was, however, not included since these participants lived at home and their health state was such that, they were capable of completing the questionnaires and attend the physical examination session.

In accordance with the algorithm for MUST score (Figure 1), the BMI (kg/m^2) was categorized into three groups; BMI ≤18.5 kg/ m^2 scored 2, BMI 18.5-20 kg/ m^2 scored 1 and lastly BMI kg/ m^2 >20 scored 0

The percentage of unplanned weight-loss was calculated by dividing the involuntary weight-loss (kg) during the last six months by the present weight (kg) plus involuntary weight loss and later multiplied the result by 100.

Weight-loss < 5 % scored 0, weight-loss between 5-10 % scored 1, lastly weight-loss > 10% scored 2. As earlier mentioned, MUST score was derived through the addition of the BMI score and the percentage unplanned weight-loss score.

The MUST score for 479 respondents could not be calculated because information about body mass index or weight loss was lacking for these respondents.

- Age was categorized into four groups; 65-69 years, 70-74 years, 75-79 years, and 80+.
- Marital status denoted as " living with a spouse or partner" was coded as 1 while being single was coded as 0.
- Education was categorized into four levels: primary/secondary school including modern secondary was coded as 1, technical /vocational school and 1-2 years of senior high school was coded as 2. High school diploma coded as 3, college/ university education less than 4 years as 4, and high school education 4 years or more coded as 5.
- Support of friends: the question was if the respondent had any friends who could give help or support when needed. They were required to answer yes or no. These answers were recoded to 1 and 0 respectively.
- Association participation indicated how often respondents participated in organized gatherings such as sports, clubs, and political meetings, and religious or other associations. The responses never or few times a year were coded 1, one to three times

a month was coded 2, approximately once a week was coded 3 and more than once a week was coded 4.

3.2.2. Dependent variables

- Visit to general practitioner (GP) last year is a dichotomous variable whereby 1 indicates one or more visits, while 0 means participant has not visited the GP during the last year. Subjects with missing information (58 subjects) were excluded from the analyses (Table 1).
- Frequency of visits to the GP, a continuous variable, was used to derive the mean number of visits to the GP in the last 12 months. Subjects with missing information (538 subjects) were excluded from the analyses.
- Visit to the medical specialist in the last 12 months includes medical examination and treatment carried out by somatic specialist (excluding psychiatrist and psychologist). This variable was dichotomized whereby 1 indicates one or more visits to the health care specialist while 0 related to no visit. Subjects with missing information (642 subjects) were excluded from the analyses (Table 1).
- Surgery within the last three years whereby 1 indicates yes and 0 implies the respondent has not undergone surgery in the mentioned period. Subjects with missing information (14 subjects) were excluded from the analyses (Table 1).

3.2.3. Data analysis

The statistical analyses in this study were performed using the SPSS for windows version 19 (SPSS Inc, Chicago, IL, USA).

All analyses are stratified by gender. Descriptive analyses were used to describe sample characteristics, some of the results are presented in average and standard deviation while cross-tabulation was used to derive proportions across BMI and MUST score categories based

on health care utilization variables. Some continuous variables such as age and BMI were, in addition, grouped into categories while health care utilization variables were dichotomized with 1and 0 as possible answers (as detailed above). The analysis of variance (ANOVA) was used in the derivation of the mean and confidence intervals for visits to GP across BMI categories and MUST scores. Logistic regression was used to analyze relationships between MUST/BMI and health care utilization and adjustment for confounding factors. The p-value for linear relationships was found by including the BMI or MUST categories as a linear term in the regression model. Odds ratio estimates are reported at 95% confidence interval (CI). Furthermore, in the logistic regression analysis, the BMI category 22.5-24.9 kg/m^2 and MUST score 0, respectively, were used as reference categories. All p-values in the tables indicate p-values for a linear relationship and are two-sided. The relationship was considered statistically significant if $p < 0.05$.

3.3. Ethical considerations

The regional board of research ethics approved the Tromsø 6 survey, and each participant gave written informed consent prior to their inclusion in the study.

4. Results

4.1. Study population

The study was carried out among community dwelling elderly individuals; 53.5% of them were women while 46.5% were men (Table 2). Table 2 outlines some unadjusted characteristics of the participants. The mean age (SD) of the female population was 72.5 (5.8) years while that of the male population is 71.6 (5.4) years. More men than women were living with a spouse/ partner. Similarly, a higher proportion of men than women had education at least at high school diploma level. The mean BMI was 27 kg/m^2 in both women and men.

Table 2 shows that according to the MUST score, 3.4% of women and 2.1 % of men were at high risk of malnutrition while 90.8% of women and 94.3% of men were at low risk of malnutrition. The total percentage at risk in women was 9.2 % (95 % CI: 7.9, 10.5) and in men 5.7 % (95 % CI: 4.6, 6.8).

Table 3 confirms the higher mean age in women than in men as displayed in table 2 and further reveals that there was no relationship between BMI and age in women, whereas old men had lower prevalence of obesity than relatively younger men. For both women and men, however, the risk of malnutrition as assessed by the MUST score was highest in older subjects (Table 4).

4.2. Associations between MUST score, demographic variables and health care utilization variables

Tables 5 and 6 display the unadjusted relationships in women and men, respectively, between MUST score categories and some variables related to health care consumption

(spouse/partner, social support, activity and education) as well as health care consumption its self (visit to GP, medical specialist and surgery).

Living alone was associated with high MUST score in women, but not in men. In both men and women, there were no statistical significant associations between MUST score and support of friends or education. In men (Table 6), but not in women (Table 5), there were indications of higher MUST score in subjects who scarcely participated in social activities (Table 6).

In men, a larger proportion in the high risk category had visited the GP ≥ 1 time in the last year (Table 6). In women, no association was found (Table 5). While subjects with high MUST scores were most likely to visit the medical specialist (Table 5 and 6), a relationship with "having undergone surgery" during the last three years was only found in women (Table 5).

4.3. Associations between body mass index, demographic variables and health care utilization variables

Tables 7 and 8 display the relationships in women and men respectively, between body mass index and health care consumption related variables (spouse/partner, social support, activity and education) and heath care consumption variables (visit to GP and medical specialist and surgery).

In both genders, there was no significant relationship between living alone, having support of friends or participation in social activities and the BMI. In women, education was associated with high BMI (Table 7). As regards health care consumption, GP consultation was positively associated with BMI in women and men. We note, however, a relatively high proportion of men with low BMI who had visited the GP last year (Table 8). In women (Table 7), there was no statistically significant association between mean numbers of GP visits and BMI,

conversely table 8 reveals that in men, the mean number of GP consultation was linearly related to BMI. There was, however, no significant relationship in men or women between BMI and visits to the medical specialist or surgery in the last three years (Table 7 and 8).

4.4. Adjusted analyses of relationships between MUST score and BMI and health care utilization

4.4.1. MUST score and health care utilization variables

Tables 9-12 outline the adjusted results of the analyses of the association between MUST score and health care consumption variables (visit to GP, medical specialist and surgery). Firstly, the analyses were adjusted for age and later for other possible confounding factors (marital status, age, education, participation in leisure activities and social support).

In both women and men (Table 9 and 10), there was no significant association between visits to GP and MUST score. A positive relationship was, however, suggested with regard to the number of consultation in women and one or more consultations in men. The 95 % confidence intervals were wide, however. There was no indication of a significant interaction by gender.

The odds of medical specialist consultation were in women higher in the high risk categories, while the relationship was of borderline statistical significance in men (Table 11). No significant interaction by gender was found, and a significant positive association was found between MUST score and at least one medical special consultation last year when data from both genders were merged ($p = 0.003$).

In women, but not in men, high MUST score was associated with increased odds of surgery (Table 12). As for the former variable, no significant interaction by gender was found

(p= 0.3) and a significant positive association was noted between MUST score and surgery the last three years (p=0.03) when data from both genders were merged.

4.4.2. Body mass index (BMI) and health care utilization variables

Tables 13-16 show the association between body mass index (BMI) and health care consumption variables (visit to GP, medical specialist and surgery). Analyses were adjusted for age and further adjustments were made for possible confounding factors (marital status, age, education, participation in leisure activities and social support).

In women (Table 13) and men (Table 14), GP visit last year was associated with BMI, those in the highest BMI categories were more likely to consult the GP. The mean number of GP consultation in both genders was higher in the higher BMI categories.

There was no significant association between BMI and visits to the medical specialist or having been subject to surgery (Table 15 and 16).

4.4.3. Gender differences

As discussed above, there were few indications that the association between either BMI or MUST score and health care utilization differed substantially between women and men.

5. Discussion

Kvamme et al have previously discussed the relationships between risk of malnutrition as well as current body mass index (BMI) and health related quality of life (HRQoL) and mental health in elderly men and women from the general population [31]. The present analyses, however, focuses on the relationships between BMI and MUST score and health care consumption.

5.1. Summary of findings

In this population-based cross-sectional study of the elderly population, the mean age in women was higher than in men, but the mean BMI was the same in both genders. Unadjusted results revealed that more women than men were at risk of malnutrition. More women than men were living alone. Single respondents were more likely to belong to the high risk category. In men, participation in social activities was associated with low risk of malnutrition.

There were (particularly when data for men and women were merged) indications of more frequent use of health care in subjects with high risk of malnutrition. The main picture regarding BMI was a positive relationship between BMI and visits to the GP, but not with the use of medical specialist or with surgery during the last three years.

5.2. Study findings in relation to other studies

5.2.1. Age and malnutrition

Ageing is associated with changes in the physiological and socio economic sphere [33]. However, the main physiological change in older adults is the loss of muscle mass. This is as a result of the normal aging process. Furthermore, it is currently unclear at what age these physiological changes commence and to what extend the changes occur in the individual [34]. These alterations, however, impair daily functioning and thus nutritional status [33]. Since the elderly are not a homogenous group [35], many studies stratify age into groups such as 65-69, 70-74, 75-79 years and 80+ . In this study, categorization of age disclosed that in women and men, the risk of malnutrition as assessed by MUST score was highest in older subjects. More so, the average age in women was higher than in men, similar to findings in a study performed by Timpini et al. whereby a higher proportion of female subjects participated in the study and more women than men were at risk of malnutrition. More so, risk of malnutrition was more frequent in the older subjects aged 75+ [36].

5.2.2. Impact of socio-economic factors on malnutrition

Social network is known to have impact on health outcomes. Equally, social engagement is associated to slower loss of cognitive function [2], good health and wellbeing [35]. However, some elderly citizens engage in informal workforce such as volunteerism or provision of help to their families after retirement [2]. In this study, support of friends and participation in social activities have been included as a possible confounder as the factors may impact both risk of malnutrition and utilization of health care services. In men, participation in social activities was associated with low risk of malnutrition. In a previous study, malnutrition was higher in those who never participated in physical and leisure activities [36] and another study revealed that having contact with neighbors was inversely related to malnutrition prevalence

[35]. In this study, we found no significant association between nutritional status and having support of friends.

It is well established that marital status may have an impact on the nutritional intake and hence health care utilization. Literature depicts that loneliness and bereavement may cause psychological ill health and consequently low nutritional intake [22, 23, 37]. In our study, malnutrition was frequent in single subjects likewise in the study by Timpini et al. [36]. In earlier investigations [38], men were seemly more vulnerable than women to the impact of eating alone, however, in our study, women were more prone to malnutrition. More so, our study likewise other studies carried out among community dwelling older adults revealed that men were more likely to be married [35, 39]. Thus, more women than men lived alone and women were at risk of malnutrition [22, 36, 37, 39].

In our study, education incorporates primary school to higher education level. In previous studies, chances of employment and sustainable livelihood have been attributed to education [37]. Further, knowledge improves an individual`s ability to understand the association between nutrition and health and therefore an additional advantage as regards to adherence to healthy life styles [35]. We found no association between education and risk of malnutrition. In other studies, there were indications of an association between education and malnutrition [35, 37]. More so, malnutrition was higher among participants with low education and income. Further, resource issues also affect the individuals autonomy; having an impact the individual`s financial ability to purchase food [37], thus old age issues can be traced back to early life experiences [2].

5.2.3. Malnutrition and health care utilization

In Norway, emphasis has been laid on social inequalities in health as well as utilization of health services. Further, one of the aims for the health service is to better services for the

vulnerable groups [40], more so, the Norwegian health care system based on universal coverage and the primary health care administered by the municipality [41] are both factors which contribute to the elimination of disparities in utilization of health care services. Nonetheless, literature highlights that the relative health differences between socio-economic groups in Norway are the highest in Europe [41]. This impression is supported by the Norwegian health directorate which points out that, old people with poor health and other less privileged in the society are not always able to make their needs and rights known. So, this can hinder these people from using the health service as opposed to the rest of the population [40]. Nevertheless, as the aging population and the proportion of chronically ill individuals is expected to rise [42], there are according WHO, expectations to the performance of the primary health care [43]. In practice , prevention of disease, improved monitoring, care and treatment of patients should be the priority of the primary health care [42] . That makes the use of GP services a relevant variable in our study.

Our findings with regard to MUST score and visits to the GP were inconsistent, but, there was a general positive association between BMI and the frequency of GP consultation. The high odds of GP consultation in the obese group could be attributed to the prevalence of chronic diseases which need regular medical attention. Nevertheless, since over 90% of the study population had one or more visits to the GP, the variation in GP visits was not quite distinct.

Referrals to the medical specialist are the GP`s responsibility. So, in this study the visits to the medical specialist have been included. In the context of this study it comprises of hospital somatic specialist outpatient services. In Norway, referrals may be made to either the public outpatient specialist or the private owned outpatient specialist, and specialist care is offered within the hospital setting [42] and adults co-pay a small fee for consultation [44] .

Results in this study indicate that those at risk of malnutrition were more likely than subjects with low MUST score to visit the medical specialist. These findings are consist with earlier investigations which revealed that women who lost weight had higher odds of hospital specialists visits and hospitalization as compared to those who did not lose weight [45]. This is an indication that the MUST tool comprising of a weight-loss component was appropriate in depicting those most likely to consult the medical specialist.

Earlier investigations indicated that low nutritional status adversely affects functional ability and therefore increases susceptibility to falls, fractures [34], emergency room visits [23], hospitalization [23, 46] and surgery. In this study, particularly women at risk of malnutrition were likely to have undergone surgery. Nonetheless, these findings could be explained by reverse causality; the surgery or the medical condition that led to the surgery (e.g. a hip fracture) resulted in weight loss and high MUST score noted in our study.

5.3. Strengths and limitations of the study

This is one of the largest studies examining health care utilization among elderly at risk of malnutrition. The response rate (66%) can be considered representative of the population (see below, however). Moreover, the physical examination gave a unique opportunity to carry out anthropometric measurement correctly, and respondents could get assistance in filling the questionnaires. Also, the assessment of nutritional status using the BMI and the reputable MUST contribute to the improvement of the study quality. The study was able to determine the prevalence of risk of malnutrition; 9.2 % of women and 5.7 % of men were at risk of malnutrition.

Bias: The study data was predominantly self-reported, so there are possibilities that participants have either over-reported or under-reported information regarding health care utilization, education or social activities and this could lead to information bias. Also the data

was collected at one point in time, thus unsuitable to determine causation. More so, the differences in the responders and the non-responders [47] is an issue; a greater proportion of respondents were those under 80 years, and probably those ≥ 80 years who did not meet for the examination were more fragile and most likely to be at risk of malnutrition. For instance, if old men with low BMI and many visits to the GP did not attend the examination, then we are faced with a bias as those with high risk of malnutrition and high odds of GP consultation are missing from the analyses.

Further, the weakness of the MUST in this study is the weight loss component, because the elderly person must recall the weight loss and, elderly are scarcely weighed under health care [48]. Moreover, the use of health care service was self-reported leading to possibilities of recall bias. Some health care utilization variables (e.g. visit to a psychiatrist/psychologist) were also excluded from the study due to few responses.

Confounding: Several possible confounding factors were not included in the analyses among them are chronic conditions, mobility and smoking. Because the reasons for seeking medical care were not assessed in this study, chronic diseases could as well be attributed with these consultations. So these factors should be considered in the interpretation of the results [45].We chose not to include information about diseases and risk factors for diseases in our analyses. There are several reasons for this, amongst which; we have information about only a few of the relevant diseases. The major reason was, however, that our focus was not on etiology (why there might be relationships between risk of malnutrition and health care consumption), but rather to describe the relationships, if present. Our interest in this topic was based on our experiences as a nurse in charge of caring for elderly people in their homes.

5.4. Recommendations

This study recommends the use of a nutritional assessment tool to complement BMI in the assessment of nutritional status. This is because there are concerns about the usage of BMI in the elderly population. It can be unreliable in the presence of confounding factors such as edema and ascites; furthermore BMI may not identify unintentional weight loss if used as a single assessment [14]. Lastly, BMI does not consider the difference in body composition [10] and postural changes [14] in elderly as opposed to younger adults. In spite of these controversies, there is wide consensus that nutritional assessment is relevant as part of care and medical evaluation of patients [10], and to accomplish this, there are several assessment tools designed for various settings such as home- dwelling or institutionalized elderly. Some tools may require theoretical and practical skills for patient assessment, such that accurate nutritional status may be dependent on the examiner`s experience, as well as reliable self-reported data from the patient [49]. However, to accomplish implementation of nutritional assessment practices in the community, issues in daily practice such as personnel attitudes [42], ethical issues, resource allocation, in-service training as well as competent management at all levels have to be dealt with. Literature suggests an integration of nutritional education in basic education for health workers and an establishment of post- graduate studies for both nurses and physicians [50]. Since most elderly citizens visit their GP on a regular basis, Metzelthin et al. revealed in their study that primary care has not been able to identify needs of the elderly [38]. To reverse this conception, other researchers have suggested interventions to target home-dwelling elderly people.

Such interventions could comprise of home visits, an early geriatric assessment [51, 52], early family support, multi-professional team [51, 53] and the involvement of the elderly and their relatives to easily identify areas of need, care and rehabilitation, as well as recognizing

the elderly and their informal givers` need for information [51]. The aim of this intervention would be an improvement of the individual`s functional ability, satisfaction with health and social care and reduce health care consumption [51, 53].

5.5. Future studies

There is need for knowledge regarding the relationship between malnutrition and health care utilization in elderly. This study was not able to determine the rate of health care utilization due to its cross-sectional design. So, in future, researchers should consider using a prospective study design. It may be a better alternative because self-reports provided by respondents can be followed up at specific intervals. This will optimize the possibility to determine the rate of health care utilization as well as incidences and causes of malnutrition [47].

5.6. Conclusion

The odds of GP consultation were highest in the obese women and men while the malnourished women had greater odds of surgery and two times greater likelihood of medical specialist consultation. However, there is ample evidence that malnutrition is prevalent in the elderly population. While it remains undiagnosed, considerable amounts of resources are being utilized in the management of its consequences on patients. Hence, nutritional assessment of the elderly should be obligatory in all clinical and care settings and this should include an individualized follow-up plan.

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Tables

Table 1 Study population and valid data. The Tromsø Study: Tromsø 6

	Women	**Men**	**Total N (%)**	**Missing**
Age distribution				
65-69 years	827	830	1657 (41.2)	
70-74 years	549	516	1065 (26.5)	
75-79 years	439	325	764 (19.0)	
≥80 years	335	196	531 (13.2)	
Total	2150	1867	**4017 (100)**	
Valid data for BMI	2142	1862	4004 (99.7)	13
Valid data for MUST score	1845	1693	3538 (88.1)	479
Valid data concerning GP consultation	2109	1850	3959 (98.6)	58
Valid data concerning medical specialist consultation*	1753	1622	3375 (84.0)	642
Valid data concerning surgery	2144	1859	4003 (99.7)	14

* A combination of two questions, respondents were obliged to answer both questions.

Table 2 Characteristics of study population. The Tromsø Study: Tromsø 6

	Women	**Men**
Number of participants	2150	1867
Mean age(SD) in years	72.6 (5.8)	71.6 (5.4)
Living with a spouse/partner (%, N)	53.6 (1074)	81.0 (1477)
High school diploma or higher education (%, N)	19.6 (404)	33.3(605)
Mean BMI (SD) (kg/m^2)	27.0 (4.6)	27.0 (3.7)
Risk of malnutrition, % (N) according to MUST		
Low risk	90.8 (1676)	94.3(1596)
Medium risk	5.7(106)	3.6 (61)
High risk	3.4 (63)	2.1(36)

Table 3 **Relationship between age and body mass index distribution according to age and gender. Percent of all subjects in the age group (number of subjects). The Tromsø study: Tromsø 6**

	Age categories					
	65-69	**70-74**	**75-79**	**80+**	**Total %(N)**	***P*-value**
Gender						
Women	49.9(827)	51.5(549)	57.5(439)	63.1(335)	53.5(2150)	<0.001
Men	50.1(830)	48.5(516)	42.5(325)	36.9(196)	46.5(1867)	
All	100.0(1657)	100.0(1065)	100.0(764)	100.0(531)	100.0(4017)	
Women						
BMI(kg/m^2)						
≤19	2.9(24)	3.8(21)	5.3(23)	4.2(14)	3.8(82)	
20-22.4	12.5(103)	10.5(58)	14.0(61)	11.1(37)	12.1(259)	
22.5-24.9	21.8(180)	19.5(107)	15.4(67)	17.4(58)	19.2(412)	0.41
25-27.49	21.5(178)	22.8(125)	21.4(93)	22.5(75)	22.0(471)	
27.5-29.9	19.1(158)	19.2(105)	20.0(87)	18.9(63)	19.3(413)	
30+	22.2(183)	24.1(132)	23.9(104)	25.8(86)	23.6(505)	
All women	100.0 (826)	100.0(548)	100.0(435)	100.0(333)	100.0(2142)	

Table 3 cont.

	Age categories					
	65-69	**70-74**	**75-79**	**80+**	**Total %(N)**	***P*-value**
Men						
BMI(kg/m^2)						
≤19	1.4(12)	1.2(6)	1.5(5)	3.6(7)	1.6(30)	
20-22.4	6.4(53)	7.2(37)	9.6(31)	11.9(23)	7.7(144)	
22.5-24.9	18.5(153)	22.1(114)	24.5(79)	24.2(47)	21.1(393)	<.001
25-27.49	27.4(227)	31.6(136)	29.7(96)	26.3(51)	28.8(537)	
27.5-29.9	24.2(201)	19.6(101)	18.9(61)	22.2(43)	21.8(406)	
30+	22.1(183)	18.4(95)	15.8(51)	11.9(23)	18.9(352)	
All men	100.0(829)	100.0(516)	100.0(323)	100.0(194)	100.0(1862)	

Table 4 **MUST Score across age categories stratified by gender. Percent of all subjects in the age group (number of subjects). The Tromsø study: Tromsø 6**

	Age categories					
	65-69	**70-74**	**75-79**	**80+**	**Total %(N)**	***P*-value**
Women						
MUST score						
0	93.5(701)	91.5(437)	87.5(328)	86.9(218)	90.8(1676)	
1	4.5(34)	5.3(25)	8.3(31)	6.4(16)	5.7(106)	<.001
2+	2.0(15)	3.2(15)	4.3(16)	6.8(17)	3.4(63)	
All women	100.0(750)	100.0(469)	100.0(375)	100.0(251)	100.0(1845)	
Men						
MUST Score						
0	95.9(730)	92.4(437)	94.8(274)	91.2(155)	94.3(1596)	
1	2.9(22)	4.2(20)	3.5(10)	5.3(9)	3.6(61)	0.02
2+	1.2(9)	3.4(16)	1.7(5)	3.5(6)	2.1(36)	
All men	100.0(761)	100.0(473)	100.0(289)	100.0(170)	100.0(1693)	

Table 5 **MUST categories by demographic and health care utilization variables for women. Percent of all women in the MUST group (number of subjects). The Tromsø study: Tromsø 6**

	MUST Categories				
	0	**1**	**2+**	**Total %(N)**	***P*-value**
% (n) living with spouse/partner	55.9(878)	49.0(49)	41.1(23)	55.0 (950)	0.01
% (n) having support of friends	85.5(1310)	85.0(85)	79.2(42)	85.2(1437)	0.27
Education					
Primary/secondary, modern secondary school	55.3(903)	51.5(50)	62.3(38)	55.4(991)	
Technical school, vocational, 1-2 years senior high school	24.1(394)	21.6(21)	19.7(12)	23.9(427)	
High school diploma	3.6(59)	6.2(6)	3.3(2)	3.7(67)	0.91
College university < 4 years	8.3(135)	8.2(8)	9.8(6)	8.3(149)	
College university ≥ 4 years	8.6 (141)	12.4(12)	4.9(3)	8.7(156)	
All women	100.0(1632)	100.0(97)	100.0(61)	100.0(1790)	
Participation in activities					
Never or few times a year	39.2(630)	44.6(45)	47.4(27)	39.8(702)	
1-3 times a month	34.8(560)	28.7(29)	26.3(15)	34.2(604)	0.24
Approximately once a week or more	26.0 (418)	26.7(27)	26.3(15)	26.0(460)	
All women	100.0(1608)	100.0(101)	100.0(57)	100.0(1766)	

Table 5 cont.

	MUST categories				
	0	**1**	**2+**	**Total %(N)**	***P*-value**
GP consultations last year					
≥ 1 GP consultations (%)	91.2(1504)	92.3(96)	91.8(56)	91.3(1656)	0.74
Mean number (SD) of consultations	3.1(3.7)	4.3(5.0)	3.6(3.2)	3.2(3.7)	0.02
% with visits to medical specialist last year	44.1(660)	55.4(51)	55.8(29)	45.1(740)	0.01
% undergone surgery last 3 years	24.8(415)	38.7(41)	36.5(23)	26.0(479)	0.001

Table 6 **MUST categories by demographic and health care utilization variables for men. Percent of all men in the MUST group (number of subjects). The Tromsø study: Tromsø 6**

	MUST Categories				
	0	**1**	**2+**	***Total* %(N)**	***P*-value**
Spouse/ Partner	81.8(1284)	84.5(49)	68.6(24)	81.6(1357)	0.16
Have support of friends	88.1(1310)	84.2(48)	80.0(28)	87.8(1386)	0.10
Education					
Primary/secondary, Modern secondary school	34.6(538)	32.2(19)	28.6(10)	34.4(567)	
Technical school, vocational, 1-2 years senior high school	31.3(487)	28.8(17)	34.3(12)	31.3(516)	
High school diploma	4.9(76)	5.1(3)	5.7(2)	4.9(81)	0.58
College university < 4 years	17.2(267)	23.7(14)	22.9(3)	17.5(289)	
College university ≥ 4 years	12.0(187)	10.2(6)	8.6(3)	11.9(196)	
All men	100.0(1555)	100.0(59)	100.0(35)	100.0(1649)	
Participation in activities					
Never or few times a year	57.2(873)	62.1(36)	80.0(28)	57.8(937)	
1-3 times a month	21.1(322)	19.0(11)	11.4(4)	20.8(337)	0.02
Approximately once a week or more	21.8(332)	10.9(5)	8.6(3)	21.4 (346)	
All men	100.0(1527)	100.0(58)	100.0(35)	100.0(1620)	

Table 6 cont.

	MUST categories				
	0	**1**	**2+**	**Total %(N)**	***P*-value**
≥ 1 GP consultations (%)	87.9(1391)	93.4(57)	97.2(35)	88.3(1438)	0.03
Mean number (SD) of consultations	3.0 (3.6)	3.0(2.8)	3.4(2.9)	3.0(3.6)	0.63
% with visits to medical specialist	43.2(635)	42.9(24)	65.6(21)	43.6(680)	0.04
% undergone surgery the last 3 years	28.2(448)	30.0(18)	30.6(11)	28.3(477)	0.67

Table 7 Population demographics and health care utilization variables by BMI categories in women. Percent of all women in the BMI group (number of women). The Tromsø study: Tromsø 6

	BMI (kg/m^2)							
	≤19	**20-22.4**	**22.5-24.9**	**25-27.4**	**27.5-29.9**	**30+**	**Total %(N)**	***P*-value**
% living with spouse/ partner	44.7(34)	52.7(127)	57.4(225)	51.5(223)	52.6(325)	55.2(259)	53.6(1070)	0.52
% having support of friends	80.0(56)	85.4(199)	86.5(326)	85.2(367)	81.0(294)	83.9(380)	84.2(1622)	0.40
Education								
Primary/secondary, school	60.3(47)	48.8(122)	52.0(211)	55.1(244)	58.8(233)	65.1(322)	57.0(1179)	
Technical school, vocational	15.4(12)	24.4(61)	24.6(100)	25.5(113)	26.0(103)	19.6(97)	23.5(486)	
High school diploma	7.7(6)	3.2(8)	5.7(23)	4.1(18)	2.5(10)	2.4(12)	3.7(77)	<.001
College/ university < 4 years	6.4(5)	10.4(26)	8.6(35)	8.1(36)	6.1(24)	7.1(35)	7.8(161)	
College/ university ≥ 4 years	10.3(8)	13.2(33)	9.1(37)	7.2(32)	6.6(26)	5.9(29)	8.0(165)	
All women	100.0(78)	100.0(250)	100.0(406)	100.0(443)	100.0(396)	100.0(495)	100.0(2068)	

Table 7 cont.

	BMI (kg/m^2)							
	≤19	**20-22.4**	**22.5-24.9**	**25-27.4**	**27.5-29.9**	**30+**	**Total %(N)**	***P*-value**
Participation in activities								
Never or few times a year	50.7(37)	40.2(97)	39.7(158)	38.0(171)	41.0(161)	39.5(188)	40.0(812)	
1-3 times a month	24.7(18)	30.3(73)	35.4(141)	33.1(149)	36.4(143)	35.9(171)	34.2(895)	0.87
Approximately once a week or more	24.7(18)	29.5(71)	24.8(99)	28.9(130)	22.7(89)	24.6(76)	25.8(524)	
All women	100.0(73)	100.0(241)	100.0(398)	100.0(450)	100.0(393)	100.0(476)	100.0(2031)	
% with ≥ 1 GP consultations	88.6(70)	90.5(228)	87.7(358)	92.6(428)	91.6(373)	94.1(464)	91.4(1921)	0.004
Mean number (SD) of consultations	2.8(2.8)	3.1(3.3)	3.0(3.4)	3.2(3.3)	3.3(4.1)	3.7(5.0)	3.3(3.9)	0.10
% with visits to medical specialist last year	50.8(33)	46.3(99)	46.2(159)	45.3(177)	49.1(168)	45.5(178)	46.6(814)	0.87
% undergone surgery the last 3 years	34.1(28)	26.6(69)	24.3(100)	23.0(108)	28.9(119)	27.8(140)	26.4(564)	0.67

Table 8 Population demographics and health care utilization variables by BMI categories in men. Percent of all men in the BMI group (number of men). The Tromsø study: Tromsø 6

	BMI (kg/m^2)							
	≤19	**20-22.4**	**22.5-24.9**	**25-27.4**	**27.5-29.9**	**30+**	**Total %(N)**	***P*-value**
% living with spouse/ partner	75.9(22)	77.6(111)	80.4(307)	83.0(436)	81.7(325)	79.8(273)	81.0(1474)	0.60
% having support of friends	76.0(19)	80.7(109)	84.6(302)	90.4(454)	91.2(342)	84.2(271)	87.2(1497)	0.08
Education								
Primary/secondary school	39.3(11)	37.1(52)	36.3(138)	31.8(167)	36.5(143)	38.2(131)	35.5(642)	
Technical school, vocational	35.7(10)	28.6(40)	30.3(115)	32.2(169)	30.4(119)	31.5(108)	31.0(561)	
High school diploma	0.0(0)	5.7(8)	4.2(16)	5.1(27)	5.6(22)	4.1(14)	4.8(87)	0.25
College/ university < 4 years	17.9(5)	13.6(19)	18.2(69)	16.4(36)	15.8(62)	19.8(68)	17.1(309)	
College/ university ≥ 4 years	7.1(2)	15.0(21)	11.1(42)	14.5(76)	11.7(46)	6.4(22)	11.6(209)	
All men	100.0(28)	100.0(140)	100.0(380)	100.0(525)	100.0(392)	100.0(343)	100.0(1808)	

Table 8 cont.

	BMI (kg/m^2)							
	≤19	**20-22.4**	**22.5-24.9**	**25-27.4**	**27.5-29.9**	**30+**	**Total %(N)**	***P*-value**
Participation in activities								
Never or few times a year	70.4(19)	68.4(97)	59.2(218)	54.3(282)	58.5(223)	59.6(201)	58.6(1034)	
1-3 times a month	14.8(4)	16.5(73)	19.6(72)	22.5(117)	20.2(77)	21.4(72)	20.6(364)	0.29
Approximately once a week or more	14.8(4)	15.0(58)	21.2(93)	23.1(122)	21.2(81)	19.0(64)	20.8(367)	
All men	100.0(27)	100.0(133)	100.0(368)	100.0(519)	100.0(381)	100.0(337)	100.0(1765)	
≥ 1 GP consultations (%)	90.0(27)	81.1(116)	87.5(342)	87.6(466)	89.0(357)	92.6(323)	88.4(1631)	0.01
Mean number of consultations during the last 12 months(SD)	2.3(2.4)	2.7(4.4)	2.8(3.4)	2.9(3.8)	3.2(3.3)	3.7(3.9)	3.0(3.6)	0.006
% with visits to medical specialist last year	50.0(12)	51.3(60)	41.3(141)	42.8(203)	46.5(164)	43.7(135)	44.2(715)	0.42
% undergone surgery the last 3 years	16.7(5)	23.2(33)	30.2(118)	29.1(156)	28.0(113)	30.8(108)	28.7(533)	0.20

Table 9 **Relationships in women between MUST score and the frequency of GP consultations last year. Odds ratio (OR) (95% confidence interval) for any consultation last year and the mean (95% confidence interval) number of consultation last year. The Tromsø 6 Study**

	OR (95% CI for any consultation)		**Mean (95% CI) number of consultations**	
MUST SCORE	**Age- adjusted**	**Extensively adjusted***	**Age-adjusted**	**Extensively adjusted***
0	1.00	1.00	3.27(3.07-3.49)	3.31(2.90-3.71)
1	0.91(0.43-1.94)	0.98(0.45-2.09)	4.44(3.65-5.23)	4.73(3.78-5.68)
2+	1.15(0.35-3.81)	1.21(0.36-4.03)	3.56(2.54-4.49)	3.60(2.32-4.88)
P-value for linear trend	0.96	0.84	0.06	0.05

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 10 **Relationships in men between MUST Score and the frequency of GP consultations last year. Odds ratio (OR) (95% confidence interval) for any consultation last year and the mean (95% confidence interval) number of consultation last year. The Tromsø 6 Study**

	OR (95% CI for any consultation)		**Mean (95% CI) number of consultations**	
MUST SCORE	**Age- adjusted**	**Extensively adjusted***	**Age-adjusted**	**Extensively adjusted***
0	1.00	1.00	3.28(3.06-3.49)	3.36(2.95-3.77)
1	2.23(0.68 -7.28)	2.25(0.68-7.42)	3.18(2.15-4.20)	3.34(2.17-4.51)
2+	3.79(0.51-28.10)	4.51(0.55-31.13)	3.53(2.28-4.77)	3.38(2.02-4.75)
P-value for linear trend	0.07	0.06	0.81	0.99

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 11 **Relationships between MUST score and odds ratio (OR) (95% confidence interval) for medical specialist consultation during the last year. The Tromsø 6 Study**

	Women		**Men**	
	OR (95% CI for any consultation)		**OR (95% CI) for any consultation**	
MUST SCORE	**Age- adjusted**	**Extensively adjusted***	**Age-adjusted**	**Extensively adjusted***
0	1.00	1.00	1.00	1.00
1	1.31(0.82-2.08)	1.31(0.82-2.11)	1.06(0.60-1.86)	1.03(0.58-1.83)
2+	2.10(1.08-4.10)	2.14(1.08-4.23)	2.08(0.98-4.42)	2.22(1.04-4.75)
P-value for linear trend	0.02	0.02	0.09	0.07

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 12 Relationships between MUST score and odds ratio (OR) (95% confidence interval) for surgery during the last year. The Tromsø 6 Study

	Women		**Men**	
	OR (95% CI) for surgery		**OR (95% CI) for surgery**	
MUST SCORE	**Age- adjusted**	**Extensively adjusted***	**Age-adjusted**	**Extensively adjusted***
0	1.00	1.00	1.00	1.00
1	1.88(1.25-2.82)	1.82(1.16-2.87)	1.07(0.61- 1.88)	1.30(0.72-2.34)
2+	1.67(0.99-2.83)	1.51(0.79-2.89)	1.09(0.53-2.33)	1.05(0.49-2.25)
P-value for linear trend	0.01	0.02	0.56	0.58

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 13 **Relationships in women between body mass index (BMI) and the frequency of GP consultations last year. Odds ratio (OR) (95% confidence interval) for any consultation last year and the mean (95% confidence interval) frequency of consultation last year.**
The Tromsø 6 Study

	OR (95% CI for any consultation)		**Mean (95% CI) frequency of consultations**	
BMI(kg/m^2)	Age- adjusted	Extensively adjusted*	Age-adjusted	Extensively adjusted*
≤19	0.98(0.46-2.10)	1.18(0.49-2.80)	2.91(2.00-3.85)	2.91(1.75-4.06)
20-22.4	1.30(0.77-2.17)	1.57(0.89-2.58)	3.25(2.72-3.77)	3.42(2.75-4.08)
22.5-24.9	1.00	1.00	3.18(2.77-3.60)	3.07(2.51-3.63)
25-27.49	1.70(1.07-2.69)	1.96(1.19-3.23)	3.35(3.00-3.74)	3.46(2.91-4.00)
27.5-29.9	1.48(0.93-2.34)	1.58(0.96-2.60)	3.46(3.04-3.87)	3.52(2.95-4.10)
30+	2.13(1.32-3.44)	2.40(1.43-4.03)	3.87(3.49-4.25)	3.92(3.38-4.46)
P-value for linear trend	0.005	0.01	0.007	0.01

*Adjusted for marital status, age, education, participation in leisure activities and social suppor

Table 14 **Relationships in men between body mass index (BMI) and the frequency of GP consultations last year. Odds ratio(OR) (95% confidence interval) for any consultation last year and the mean (95% confidence interval) frequency of consultation last year. The Tromsø 6 Study**

	OR (95% CI for any consultation)		Mean (95% CI) frequency of consultations	
BMI(kg/m^2)	**Age- adjusted**	**Extensively adjusted***	**Age-adjusted**	**Extensively adjusted***
≤19	1.31(0.38-4.54)	0.92(0.25-3.35)	2.49(1.17-3.81)	1.85(0.30-3.40)
20-22.4	0.60(0.35-1.01)	0.61(0.34-1.09)	2.87(2.25-3.50)	2.94(2.20-3.69)
22.5-24.9	1.00	1.00	3.00(2.61-3.38)	3.12(2.58-3.65)
25-27.49	1.05(0.70-1.56)	0.98(0.63-1.51)	3.23(2.88-3.57)	3.30(2.80-3.79)
27.5-29.9	1.29(0.83-2.00)	1.16(0.72-1.87)	3.51(3.12-3.91)	3.63(3.09-4.18)
30+	2.03(1.23-3.37)	1.76(1.00-3.03)	4.10(3.68-4.53)	4.17(3.60-4.73)
P-value for linear trend	0.001	0.003	<0.001	<0.001

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 15 Relationships between body mass index (BMI) and odds ratio (OR) (95% confidence interval) for medical specialist consultation during the last year. The Tromsø 6 Study

	Women		**Men**	
	OR (95% CI for any consultation)		**OR (95% CI for any consultation)**	
BMI(kg/m^2)	**Age- adjusted**	**Extensively adjusted***	**Age- adjusted**	**Extensively adjusted***
≤19	1.15(0.67-1.96)	1.33(0.72-2.46)	1.43(0.62-3.28)	1.40(0.59-3.38)
20-22.4	0.98(0.69-1.38)	0.83(0.56-1.23)	1.50(0.98-2.29)	1.48(0.94-2.38)
22.5-24.9	1.00	1.00	1.00	1.00
25-27.49	0.94(0.70-1.28)	0.90(0.65-1.24)	1.06(0.80-1.41)	1.08(0.79-1.46)
27.5-29.9	1.10(0.82-1.49)	1.11(0.79-1.55)	1.25(0.92-1.69)	1.28(0.92-1.77)
30+	0.95(0.71-1.27)	0.97(0.70-1.34)	1.11(0.81-1.52)	1.20(0.86-1.69)
P- value for linear trend	0.89	0.78	0.95	0.75

*Adjusted for marital status, age, education, participation in leisure activities and social support

Table 16 Relationships between body mass index (BMI) and odds ratio (OR) (95% confidence interval) for surgery during the last three years. The Tromsø 6 study

	Women		**Men**	
	OR (95% CI for surgery)		**OR (95% CI for surgery)**	
BMI(kg/m^2)	**Age- adjusted**	**Extensively adjusted***	**Age- adjusted**	**Extensively adjusted***
≤19	1.58(0.95-2.63)	1.57(0.86-2.85)	0.46(0.17-1.24)	0.64(0.23-1.77)
20-22.4	1.12(0.78-1.60)	1.22(0.82-1.82)	0.69(0.44-1.08)	0.77(0.46-1.23)
22.5-24.9	1.00	1.00	1.00	1.00
25-27.49	0.92(0.68-1.26)	1.03(0.73-1.46)	0.96(0.72-1.28)	1.00(0.73-1.38)
27.5-29.9	1.25(0.92-1.71)	1.39(0.98-1.96)	0.92(0.68-1.26)	1.02(0.73-1.43)
30+	1.19(0.88-1.60)	1.34(0.96-1.87)	1.07(0.78-1.46)	1.18(0.84-1.67)
P-value for linear trend	0.45	0.31	0.11	0.75

*Adjusted for marital status, age, education, participation in leisure activities and social support

Appendices

Appendix 1: Relevant questions from Questionnaire 1: Tromsø 6

Tromsø-undersøkelsen

Skjemaet skal leses optisk. Vennligst bruk blå eller sort penn. Du kan ikke bruke komma, bruk blokkbokstaver.

2007 – 2008 KONFIDENSIELT

HELSE OG SYKDOMMER

1 **Hvordan vurderer du din egen helse sånn i alminnelighet?**

- ☐ Meget god
- ☐ God
- ☐ Verken god eller dårlig
- ☐ Dårlig
- ☐ Meget dårlig

2 **Hvordan synes du at helsen din er sammenlignet med andre på din alder?**

- ☐ Mye bedre
- ☐ Litt bedre
- ☐ Omtrent lik
- ☐ Litt dårligere
- ☐ Mye dårligere

3 **Har du eller har du hatt?**

	Ja	Nei	Alder første gang
Hjerteinfarkt	☐	☐	
Angina pectoris *(hjertekrampe)*	☐	☐	
Hjerneslag/hjerneblødning	☐	☐	
Hjerteflimmer *(atrieflimmer)*	☐	☐	
Høyt blodtrykk	☐	☐	
Beinskjørhet *(osteoporose)*	☐	☐	
Astma	☐	☐	
Kronisk bronkitt/emfysem/KOLS	☐	☐	
Diabetes	☐	☐	
Psykiske plager *(som du har søkt hjelp for)*	☐	☐	
Lavt stoffskifte	☐	☐	
Nyresykdom, unntatt urinveisinfeksjon	☐	☐	
Migrene	☐	☐	

4 **Har du langvarige eller stadig tilbakevendende smerter som har vart i 3 måneder eller mer?**

☐ Ja ☐ Nei

5 **Hvor ofte har du vært plaget av søvnløshet de siste 12 måneder?**

- ☐ Aldri, eller noen få ganger
- ☐ 1-3 ganger i måneden
- ☐ Omtrent 1 gang i uken
- ☐ Mer enn 1 gang i uken

6 **Under finner du en liste over ulike problemer. Har du opplevd noe av dette den siste uken (til og med i dag)?** (Sett ett kryss for hver plage)

	Ikke plaget	Litt plaget	Ganske mye	Veldig mye
Plutselig frykt uten grunn	☐	☐	☐	☐
Føler deg redd eller engstelig	☐	☐	☐	☐
Matthet eller svimmelhet	☐	☐	☐	☐
Føler deg anspent eller oppjaget	☐	☐	☐	☐
Lett for å klandre deg selv	☐	☐	☐	☐
Søvnproblemer	☐	☐	☐	☐
Nedtrykt, tungsindig	☐	☐	☐	☐
Følelse av å være unyttig, lite verd	☐	☐	☐	☐
Følelse av at alt er et slit	☐	☐	☐	☐
Følelse av håpløshet mht. framtida	☐	☐	☐	☐

BRUK AV HELSETJENESTER

7 **Har du i løpet av de siste 12 måneder vært hos:** Hvis JA; Hvor mange ganger?

	Ja	Nei	Ant ggr
Fastlege/allmennlege	☐	☐	
Psykiater/psykolog	☐	☐	
Legespesialist utenfor sykehus *(utenom fastlege/allmennlege/psykiater)*	☐	☐	
Fysioterapeut	☐	☐	
Kiropraktor	☐	☐	
Annen behandler *(homøopat, akupunktør, fotsoneterapeut, naturmedisiner, håndspålegger, healer, synsk el.l)*	☐	☐	
Tannlege/tannpleier	☐	☐	

8 **Har du i løpet av de siste 12 måneder vært på sykehus?**

	Ja	Nei	Ant ggr
Innlagt på sykehus	☐	☐	
Konsultasjon ved sykehus uten innleggelse;			
Ved psykiatrisk poliklinikk	☐	☐	
Ved annen sykehuspoliklinikk	☐	☐	

9 **Har du gjennomgått noen form for operasjon i løpet av de siste 3 årene?**

☐ Ja ☐ Nei

BRUK AV MEDISINER

10 **Bruker du, eller har du brukt, noen av følgende medisiner?** (Sett ett kryss for hver linje)

	Aldri brukt	Nå	Før	Alder første gang
Medisin mot høyt blodtrykk	☐	☐	☐	
Kolesterolsenkende medisin	☐	☐	☐	
Medisin mot hjertesykdom	☐	☐	☐	
Vanndrivende medisin	☐	☐	☐	
Medisin mot beinskjørhet *(osteoporose)*	☐	☐	☐	
Insulin	☐	☐	☐	
Diabetesmedisin *(tabletter)*	☐	☐	☐	
Stoffskiftemedisinene Thyroxin/levaxin	☐	☐	☐	

11 **Hvor ofte har du i løpet av de siste 4 ukene brukt følgende medisiner?** (Sett ett kryss pr linje)

	Ikke brukt siste 4 uker	Sjeldnere enn hver uke	Hver uke, men ikke daglig	Daglig
Smertestillende på resept	☐	☐	☐	☐
Smertestillende reseptfrie	☐	☐	☐	☐
Sovemidler	☐	☐	☐	☐
Beroligende medisiner	☐	☐	☐	☐
Medisin mot depresjon	☐	☐	☐	☐

12 **Skriv ned alle medisiner – både de med og uten resept – som du har brukt regelmessig i siste 4 ukers periode.** (Ikke regn med vitaminer, mineraler, urter, naturmedisin, andre kosttilskudd etc.)

Får du ikke plass til alle medisiner, bruk eget ark.

VED FRAMMØTE vil du bli spurt om du har brukt antibiotika eller smertestillende medisiner de siste 24 timene. Om du har det, vil vi be om at du oppgir preparat, styrke, dose og tidspunkt

FAMILIE OG VENNER

13 **Hvem bor du sammen med?** (Sett kryss for hvert spørsmål og angi antall)

	Ja	Nei	Antall
Ektefelle/samboer	☐	☐	
Andre personer over 18 år	☐	☐	
Personer under 18 år	☐	☐	

14 **Kryss av for de slektninger som har eller har hatt**

	Foreldre	Barn	Søsken
Hjerteinfarkt	☐	☐	☐
Hjerteinfarkt før fylte 60 år	☐	☐	☐
Angina pectoris *(hjertekrampe)*	☐	☐	☐
Hjerneslag/hjerneblødning	☐	☐	☐
Beinskjørhet *(osteoporose)*	☐	☐	☐
Magesår/tolvfingertarmsår	☐	☐	☐
Astma	☐	☐	☐
Diabetes	☐	☐	☐
Demens	☐	☐	☐
Psykiske plager	☐	☐	☐
Rusproblemer	☐	☐	☐

15 **Har du nok venner som kan gi deg hjelp når du trenger det?**

☐ Ja ☐ Nei

16 **Har du nok venner som du kan snakke fortrolig med?**

☐ Ja ☐ Nei

17 **Hvor ofte tar du vanligvis del i foreningsvirksomhet som for eksempel syklubb, idrettslag, politiske lag, religiøse eller andre foreninger?**

☐ Aldri, eller noen få ganger i året
☐ 1-2 ganger i måneden
☐ Omtrent 1 gang i uken
☐ Mer enn en gang i uken

ARBEID, TRYGD OG INNTEKT

18 **Hva er din høyeste fullførte utdanning?** (Sett ett kryss)

☐ Grunnskole, framhaldsskole eller folkehøyskole
☐ Yrkesfaglig videregående, yrkesskole eller realskole
☐ Allmennfaglig videregående skole eller gymnas
☐ Høyskole eller universitet, mindre enn 4 år
☐ Høyskole eller universitet, 4 år eller mer

19 **Hva er din hovedaktivitet?** (Sett ett kryss)

☐ Yrkesaktiv heltid
☐ Yrkesaktiv deltid
☐ Arbeidsledig
☐ Hjemmeværende
☐ Pensjonist/trygdet
☐ Student/militærtjeneste

6. ALKOHOL

6.01 **Hvor ofte har du det siste året:**	Aldri	Sjeldnere enn månedlig	Månedlig	Ukentlig	Daglig, eller nesten daglig
Ikke klart å stoppe og drikke alkohol når du først har begynt?	☐	☐	☐	☐	☐
Ikke klart å gjøre det som normalt forventes av deg fordi du har drukket?	☐	☐	☐	☐	☐
Trengt en drink om morgenen for å få komme i gang etter en rangel?	☐	☐	☐	☐	☐
Følt skyld eller anger etter at du har drukket?	☐	☐	☐	☐	☐
Ikke klart å huske hva som skjedde kvelden før på grunn av at du hadde drukket?	☐	☐	☐	☐	☐

	Aldri	Ja, men ikke det siste året	Ja, det siste året
6.02 **Har du eller andre noen gang blitt skadet på grunn av at du har drukket?**	☐	☐	☐
Har en slektning, venn, lege, eller annet helsepersonell vært bekymret for din drikking, eller foreslått at du reduserer inntaket?	☐	☐	☐

7. VEKT

7.01 **Har du ufrivillig gått ned i vekt siste 6 måneder?**

☐ Ja ☐ Nei

Hvis JA: Hvor mange kilo? ☐☐

7.02 **Anslå din vekt da du var 25 år gammel:**

Antall hele kg ☐☐

7.03 **Er du fornøyd med vekta di nå?**

☐ Ja ☐ Nei

7.04 **Hvilken vekt ville du være tilfreds med (din trivselsvekt):**

Antall kg ☐☐

8. LØSEMIDLER

8.01 **Hvor mange timer i uka driver du med følgende fritids- eller yrkesaktiviteter:**
Bilreparasjoner/lakkering, keramikkarbeid, maling/lakkering/løsemidler, frisør, glassmester, elektriker (Sett 0 om du ikke driver med slike fritids eller yrkesaktiviteter)

Antall timer per uke i gjennomsnitt ☐☐

8.02 **Bruker du hårfargemidler?**

☐ Ja ☐ Nei

Hvis JA, hvor mange ganger per år? ☐☐

Appendix 2: Relevant questions from Questionnaire 2: Tromsø 6:

Tromsø 6

- en del av Tromsøundersøkelsen

9.10 **Har du i løpet av de siste 12 måneder vært til undersøkelse eller behandling i spesialist-helsetjenesten?**

☐ Ja ☐ Nei

Hvis JA, snakket legen(e) til deg slik at du forstod dem? Svar på en skala fra 0 til 10, hvor 0=de var vanskelige å forstå og 10=de var alltid enkle å forstå

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9.11 **Hvordan vil du karakterisere behandlingen eller rådgivningen du fikk siste gang du var hos spesialist?** Svar på en skala fra 0 til 10, hvor 0=meget dårlig og 10=meget god

0	1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

9.12 **Har du noen gang før 2002 gjennomgått en operasjon på sykehus eller spesialist-klinikk?**

☐ Ja ☐ Nei

9.13 **Har du i løpet av de siste 12 måneder brukt urtemedisin , naturmidler eller naturlegemidler?**

☐ Ja ☐ Nei

9.14 **Har du i løpet av de siste 12 måneder brukt meditasjon, yoga, qi gong eller thai chi som egenbehandling?**

☐ Ja ☐ Nei