## Abstract

### Background

The anorexia of ageing is an important factor in the development of malnutrition, frailty and sarcopenia amongst the older population and is a particular problem for hospital inpatients. This study assessed factors associated with appetite in a group of hospitalised older adults, to identify potential preventive strategies.

### Design

Cross sectional observational study.

### Setting

Eleven wards in one large hospital in England.

### Subjects

Older inpatients aged 70 years and over, admitted non-electively.

### Methods

Appetite was assessed using the 4-item Simplified Nutritional Appetite Questionnaire (SNAQ). Associations between SNAQ score and appetite-related factors present in the dataset were assessed in continuous analyses, including physical activity, mood, medication, cognition and living circumstance.

### Results

200 participants, mean age of 80.7 years (SD 6.9); 40% female. Prevalence of poor appetite was 43%. In univariate analyses lower medication count, higher level of physical activity and better mood were associated with higher SNAQ scores during admission. In a multivariate analysis, independent associations of higher levels of physical activity and better mood with higher SNAQ scores during hospital admission remained.

### Conclusion

In this group of older adults, better mood and higher levels of habitual physical activity were independently associated with better appetite during hospital admission. These are potentially modifiable factors and could be targets for future research into interventions for the anorexia of ageing in the hospitalised older population.

## Key Words

Appetite, Older people, Nutrition, Hospitalised, Mood, Physical activity

**Short Report: 1500 words, 2 tables or figures and 30 references.**

## Introduction

Appetite loss amongst older individuals is common and a particular problem for hospitalised older adults, affecting 30% to 50% [1-4]. Poor appetite is linked to malnutrition, sarcopenia and frailty, leading to disability and increased healthcare utilisation [5-7]. Specific to the hospital setting, poor appetite during inpatient stay is linked to higher rates of nosocomial infection and reduced muscle strength and higher mortality post hospital discharge [2-4]. Identification and timely intervention on poor appetite could consequently be a valuable approach to prevent onset or progression of poor health outcomes for older individuals [8].

Despite increasing recognition of the importance of poor appetite, there remains poor understanding of its determinants and few management strategies [9, 10]. Poor appetite is commonly related to medical conditions and subsequent treatment, but it can also derive from age-related effects in anorexia of ageing [11, 12]. Evidence is limited for potentially modifiable psychosocial and lifestyle factors, such as physical activity, which may be influential in the pathogenesis of anorexia of ageing. This lack of knowledge is particularly the case for hospitalised populations, where sparse evidence includes observed associations of poor dentition [13] and lower mood with poorer appetite [2, 4] but is otherwise an under-researched setting.

We have previously described a framework of influences on appetite, which acknowledges their wide-range and complexity and categorises them into physiology (factors important in maintaining energy homeostasis), hedonism (factors in food and eating-related reward) and wider external cues (socio-environmental prompts stimulating food consumption) [11]. In this study, we utilised this framework to identify appetite-related factors in a dataset of hospitalised older individuals, with particular interest on potentially modifiable influences. We aimed to explore the association of these factors with appetite during hospital admission to detect potential candidates for novel or repurposed interventions for anorexia of ageing in the hospital setting.

## Methods

### Study population

This secondary analysis on anonymised data of hospital inpatients collected in 2014-15 included participants aged 70 years and over with emergency admissions in one large hospital in England and able to provide written informed consent [14]. The UK Health Research Authority London-Chelsea Research Ethics Committee (14/LO/1363) provided ethical approval for the study; participants consented for their anonymised data to be used for future research analyses.

### Data collection

Participant demographics included age and gender and medical conditions (Charlson comorbidity index score calculated [15]), body mass index (BMI), malnutrition risk using the Malnutrition Universal Screening Tool (MUST) [20] and length of hospital stay prior to baseline assessment. Ability in activities of daily living was assessed by the Modified Barthel Index [16]. Grip strength was measured using a standardised protocol [17] with low grip strength defined as <16kg for women and <27kg for men [18, 19].

Appetite was assessed with the Simplified Nutritional Appetite Questionnaire (SNAQ) during hospital stay [21]. A score of <14 out of 20 in those aged >65 years is indicative of poor appetite [21].

Factors that influence appetite in the dataset were categorised into physiology, hedonism and external cues [11]. Physiological factors included medication count and habitual physical activity (assessed via the Physical Activity Scale for the Elderly (PASE)) during the seven days prior to admission. The hedonic factor of mood was assessed using the Geriatric Depression Scale 15 item version (GDS-15) [23]. External cues included participants usual residence (living in own home alone, living in own home with others, sheltered accommodation or care home) and cognition, via the Mini-Mental State Examination (MMSE) [24].

### Statistical Analysis

Data were analysed using SPSS (SPSS IBM Corp version 24). Participant characteristics are described for the whole group and sub-groups categorised according to reported appetite: poor (SNAQ score <14) and good (SNAQ score ≥14). Differences between characteristics of the poor and good appetite groups were assessed using independent t-tests, Mann Whitney U tests and chi-squared tests, as appropriate. The relationship between appetite (SNAQ score) during hospital admission and potential influential factors was analysed via regression in unadjusted analysis. Statistical significance was determined as P≤0.05. Factors associated with appetite in unadjusted analyses were examined in a multivariable model to assess independence.

## Results

### Characteristics of the study population and between those with good and poor appetite

Most (94%) participants lived in their own home; the mean age was 80.7 years (SD 6.9); 80 (40%) were female. Median length of stay in hospital prior to assessment was four days (IQR 2-7). Characteristics of all participants are summarised in Table 1. The participants had low grip strength (56% of women and 63% of men had low grip strength according to EWGSOP II criteria) but relatively little functional dependency (median Barthel index 88 (IQR 71-100)). Most were at low malnutrition risk according to MUST (85% in low-risk category) and had a median BMI of 25.7 (IQR 22.5-28.6).

Eighty-six participants had poor appetite according to SNAQ (score <14) (47% female). Characteristics of participants with good (SNAQ score ≥14; n=114 (57%)) or poor appetite (SNAQ score <14; n= 86 (43%)) are summarised in Table 1. People with poor appetite had more comorbidities (comorbidity index score of 6 vs 5; P=0.050) and a lower proportion at low risk of malnutrition (73% vs. 85%; P=0.054) (Table 1). The differences in age, gender, modified Barthel Index, BMI MUST category and grip strength between participants with good or poor appetite were not significant. There was no difference in length of time in hospital prior to assessment or total length of stay between the groups.

### Association between SNAQ score and appetite-related factors

Factors that influence appetite, according to our structured approach [11] and present in the dataset included living circumstance (living alone in own home n=77 (38.5%), in sheltered accommodation or care home n=13 (6.5%)) compared to living in own home with others (n= 110 (55%)), level of cognition (total group median MMSE score 28 (IQR 25-29)), number of medications (total group median number 8 (IQR 6-11)), mood (total group median GDS-15 score 4 (IQR 2-5), suggestive of no depressive symptoms), and habitual physical activity (total group median PASE score 50 (IQR 25-114) out of 793, indicating low levels of activity).

In univariate analyses, a lower number of medications (unadjusted co-efficient -.112; 95% CI-.21,-.01; P=0.031), a higher level of physical activity (unadjusted co-efficient .009; 95% CI .004, .014; P=0.001) and a better mood (unadjusted co-efficient -.247; 95% CI -.376, -.118; P<0.001) were associated with higher SNAQ scores, indicating better appetite during admission (Supplementary Table 1).

In the multivariate analysis that included number of medications, level of habitual physical activity and mood, the associations between higher level of physical activity and better mood with better level of appetite remained (P=0.038 and P=0.035 respectively) indicating independent effects in the model; standardised co-efficients within the model indicated similar magnitudes of association with appetite (Table 2). The association with medication count was attenuated in the multivariate model.

## Discussion

In this secondary analysis of 200 hospitalised older people, the prevalence of poor appetite was in line with previous estimates at 43% [1, 2, 4]. We categorised factors that influence appetite using a structured approach [11], observing higher habitual physical activity and better mood independently associated with better appetite during hospital admission.

The relationship between appetite and habitual physical activity is complex and under-researched, particularly in older populations. There is evidence in younger adult populations for a J-shaped curve between oral intake and habitual physical activity, with higher oral intake at greater amounts of activity, which drops with falling activity but rises again at very low activity [25]. But when considering older populations, evidence between habitual physical activity and appetite is scarce [26], so our findings in this hospitalised population are a useful addition. The PASE questionnaire is a self-report of habitual physical activity, with this study assessing 7 days prior to hospital admission (with a median hospital stay of 4 days before assessment). The overall habitual physical activity of the group (median PASE score of 50) was lower than other community estimates for older people, reported to range from 114 to 155 [27-29], possibly indicating reduced activity due to acute illness in the period before hospital admission. Despite this, our findings suggest an older individual’s habitual physical activity prior to admission remains important for appetite during hospital stay. A link between pre-admission habitual activity and appetite during hospital stay may also have implications for planned admissions, for example in design and understanding of pre-habilitation strategies (interventions aimed at improving an individual’s physiological and psychological resilience prior to an expected major stressor, such as surgery [31]). It is also noteworthy that older adults undertake very low physical activity in hospital [30] and it remains uncertain how these very low levels relate to appetite during longer lengths of stay. There is a need to understand the endurance of association between physical activity prior to admission and appetite during hospital stay and how inpatient physical activity might impact.

We also identified that better mood was associated with greater appetite during hospital stay; this is consistent with a prior study in hospitalised older women in the UK [2] and a population from The Netherlands [4]. It is important to note however, that the effects of acute illness may be important in this association, in view of the known link between mood and level of inflammation [32, 33], as well as emerging evidence of associations between inflammation and appetite specific to hospitalised older people [34, 35]. This analysis did not include a measure of acute illness or inflammation, however the relationship between lower mood and poorer appetite in this study was independent of the number of comorbidities. Consistent with this finding, links between lower mood and poorer appetite have also been described in community dwelling older people [36, 37], where effects of acute illness would be expected to be lessened. It is also noteworthy that in this study the GDS-15 scores highlighted low-level mood change rather than clinical depression. This is likely to impact choice of potential strategies and may indicate utility in lower-intensity psychological and behavioural interventions [38], rather than diagnosis and management of depression.

The associations of better mood and higher habitual physical activity with better appetite showed independent effects in this study. This is interesting when placed in the context of observed positive associations between mood and physical activity [39, 40]. Further studies are required to fully explore their relationship with appetite and one another, particularly over time and in the context of factors such as inflammation. This will aid in determining optimal design and timing for potential interventions on physical activity and mood relating to poor appetite for hospital populations.

### Study limitations

This study was a secondary analysis therefore, data on some appetite-associated factors were not collected, which may have impacted upon results. As indicated by the Barthel index and MMSE, this study group represent hospitalised older people at higher levels of function and cognition, so may have underestimated prevalence of poor appetite. Data on physical activity was based on the 7-days prior to hospitalisation, which may have been reduced due to acute illness, therefore assessment over a longer prior period would be of utility. The findings are from a single study population and so further studies are required to determine generalisability of the results.

## Conclusions

The anorexia of ageing is common and a particular problem for hospitalised older people. There is a need to explore potentially modifiable factors related to appetite in older adults to aid design of future management strategies for anorexia of ageing. In this group of hospitalised older adults, the prevalence of poor appetite was 43%. We found better mood and higher level of habitual physical activity prior to admission were independently associated with better appetite during hospital admission. Mood and level of habitual physical activity are potentially modifiable factors related to appetite and represent a potential focus of future research into intervention candidates for the anorexia of ageing in the hospital setting.

**Table 1:** Characteristics of participants comparing good and poor appetite according to SNAQ

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristic** | **Total (n=200)** | **Good appetite**  **(SNAQ ≥14) (n=114)** | **Poor appetite**  **(SNAQ <14) (n=86)** | **p-value** |
| Age\* | 81 (7) | 81 (7) | 81 (7) | 0.898 |
| Females^ | 80 (40%) | 40 (35%) | 40 (47%) | 0.103 |
| Charlson Comorbidity Index$ | 5 (4-7) | 5 (4-6) | 6 (4-7) | 0.050 |
| Barthel Index$ | 88 (71-100) | 88 (71-100) | 87 (71-98) | 0.857 |
| Grip strength (kg)$  Males  Females | 23 (19-30)  14 (10-18) | 25 (19-32)  14 (12-20) | 22 (18-28)  12 (10-18) | 0.204  0.540 |
| Body Mass Index$ | 26 (21-29) | 26 (23-29) | 25 (22-28) | 0.425 |
| Malnutrition Universal Screening Tool^  Low risk  Medium risk  High Risk | 160 (80%)  20 (10%)  20 (10%) | 97 (85%)  10 (9%)  7 (6%) | 63 (73%)  10 (12%)  13 (15%) | 0.054  0.487  0.058 |
| Length of hospital stay prior to assessment$ | 4 (2-7) | 4 (1-8) | 3 (1-6) | 0.080 |
| Total length of hospital stay$ | 11 (5-19) | 11 (4-21) | 11 (5-19) | 0.800 |

\*Reported as mean (standard deviation), $Reported as median (interquartile range), ^ Reported as frequency (percent).

**Table 2.** Multivariable model- SNAQ score and appetite-related factors

|  |  |  |  |
| --- | --- | --- | --- |
| **Factor** | **Co-efficients (95% CI)** | **Standardised co-efficients** | **p-value** |
| Number of medications | -.050 (-.152, .053) | -.076 | 0.338 |
| Habitual Physical Activity (PASE) | .006 (.000,.012) | .174 | **0.038** |
| Mood (GDS-15) | -.166 (-.321, -.011) | -.170 | **0.035** |

PASE= Physical activity Scale for the Elderly, GDS-15= Geriatric Depression Scale 15 item

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