ORIGINAL RESEARCH

FACTORS THAT INFLUENCE DIETARY INTAKE IN ADULTS WITH STABLE CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Running head: Factors influencing dietary intake in adults with COPD

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Abstract

Aim: Malnutrition is common amongst people with chronic obstructive pulmonary disease (COPD) and nutrition status is an important determinant of symptoms, morbidity and prognosis. Inadequate diet is recognised as a contributor to malnutrition in this population; however, there are limited studies exploring individual perspectives on nutrition amongst people with COPD. The aim of this study was to identify factors that influence dietary intake patterns in a metropolitan, stable COPD population.

Methods: This qualitative study investigated participants with stable COPD who attend pulmonary rehabilitation programs. Thirty participants underwent body composition measurements, completed a validated food frequency questionnaire and participated in a semi-structured interview to explore influences on food choices. Qualitative responses were examined using thematic analysis to identify major barriers and enablers shaping nutrition related behaviours.

Results: Mean ($\pm$ SD) body mass index was $26.6 \pm 7.6 \text{ kg/m}^2$. Analysis of food intake showed inadequate servings per day of dairy, fruit and vegetables. Common themes influencing food choices included: breathlessness and fatigue affecting appetite, swallowing problems, limited social and financial supports, reduced motivation, and limited knowledge about the impact of nutrition on COPD.

Conclusions: Nutrition assessment of patients with COPD should encompass physical and social symptoms influencing dietary intake and support networks that promote healthy eating behaviours. Nutrition intervention should be tailored to individual circumstances, with ongoing follow-up to maintain motivation and adapt to changing clinical status.

Key words: chronic obstructive pulmonary disease, food habits, nutrition, pulmonary rehabilitation, qualitative analysis.

Introduction

Chronic obstructive pulmonary disease (COPD) is a major global cause of death^{1,2} and nutrition status is an important contributor to symptoms, disability and prognosis.¹⁻⁴ Malnutrition (including sarcopenia and cachexia) is well recognised in COPD with a reported prevalence of 19-60%.⁵ COPD, particularly in the advanced stages, is typically associated with weight loss and muscle wasting.^{1-3,6-8} Low body weight and loss of fat-free mass (FFM) increase all-cause mortality^{4,9-12} and are associated with impaired pulmonary status, increased complications, lower exercise capacity and poorer quality of life compared to adequately nourished individuals with COPD.^{10,12-14} Low fat-free mass index (FFMI), reflecting FFM relative to height, predicts COPD mortality more strongly than either body mass index (BMI) or lung function impairment.¹¹ Contributors to malnutrition in COPD include elevated energy expenditure due to work of breathing

and exertional costs of physical activity;^{1,3,5,6,9} inadequate intake due to anorexia, early satiety and shortness of breath;^{2,5} and systemic inflammation related cachexia.^{1,3,5-7,9}

The evidence base for nutrition intervention in COPD relates predominantly to oral nutrition support (ONS) prescription^{14,15} and there is an absence of studies using a patient-centered approach (e.g. Medical Nutrition Therapy). Previous studies show inconsistent effects of ONS and food fortification to improve nutritional parameters in COPD,^{13,16,17} however recent systematic reviews suggest some clinically important nutritional status benefits.^{14,15} The inconsistent response to nutrition support may be related, in part, to insufficient attention to the issues contributing to poor intake. Further issues that may negatively impact nutrient intake include age-associated chemosensory losses, particularly taste and smell;^{18,19} poor dental health; fatigue and/ or depression;⁵ social isolation;^{5,18,19} medication side-effects;^{5,19} insufficient financial resources contributing to food insecurity;^{18,19} and practical difficulties in housekeeping, food shopping and cooking.^{5,19}

Patients with COPD who are overweight or obese are at increased risk of other comorbidities, such as cardiovascular disease²⁰ but the evidence remains inconclusive as to the association between obesity and COPD outcomes. An “obesity paradox” has been described²⁰ due to observations of lower mortality for overweight and obese individuals with severe COPD contrasting with higher mortality for those with mild to moderate disease.²¹

There are limited studies exploring influences on food intake amongst people with COPD. In particular, there are few qualitative studies that investigate these factors from

the patient's perspective. Clinical awareness of the impact that dietary factors may have on COPD progression and outcomes is limited.³ Greater understanding of these issues is crucial for improving nutritional status in COPD. This investigation aimed to identify factors that influence dietary intake patterns in a stable COPD population attending pulmonary rehabilitation programs (PRP) using a qualitative-methods approach.

Methods

Thirty adults with stable COPD participated in this qualitative study during 2013. The targeted sample size was chosen to provide a range of nutritional states, age and social backgrounds, whilst also allowing for saturation of responses into common themes. Participants were recruited from outpatient and community pulmonary rehabilitation programs (PRP) conducted across three metropolitan sites in Melbourne, Australia. Pulmonary rehabilitation is an individualised program designed to optimise physical and social wellbeing using a multi-disciplinary approach. Inclusion criteria were: COPD, defined by post-bronchodilator forced expiratory volume in 1 second (FEV₁) to forced vital capacity (FVC) ratio <0.7 on spirometry;⁴ clinically stable, defined by no recent (within 1 month) acute respiratory exacerbations requiring antibiotics, corticosteroids or hospital admission; community-living; currently undertaking PRP or maintenance rehabilitation; and adequate literacy in English to complete study requirements.

Exclusion criteria were: other lung co-morbidities (bronchiectasis, interstitial lung disease, lung cancer); awaiting or previously undergone lung transplantation; severe or

uncontrolled co-morbidities that impact nutrition status including acute cardiac, hepatic or renal disease; inability to complete study requirements; and home-bound or residing in residential care.

The study was approved by the Alfred Health Ethics Committee. Written informed consent was required prior to participation. Eligible clients attending participating PRPs were approached by the researcher (N.S.) or an independent Allied Health clinician. Interviews and all assessments were completed in a single session.

Participants underwent measurements wearing light clothing and without shoes. Multi-frequency bioelectrical impedance analysis (BIA) (*ImpediMed SFB7 Meter Pty Ltd*, Brisbane, Australia) was undertaken lying in a supine position with electrodes placed on the right side of the body (proximally between the distal prominences of the radius and ulna, and the distal end of the third metacarpal; and distally between the median and lateral malleoli at the ankle, and the distal end of the third metatarsal). Fat-free mass (FFM) was calculated using the algorithm supplied by the manufacturer. Height (centimetres) was measured using a wall-mounted stadiometer to the nearest 0.5cm and weight (kilograms) was measured to the nearest 0.1kg using calibrated electronic scales (*A&D*, Adelaide, Australia). Umbilical (waist) circumference (centimetres) was measured and classified as greater than recommended if >94cm (males) or >80cm (females).²² Presence of oedema was assessed and measurements excluded if warranted.

Body mass index was calculated from weight and height and classified according to the World Health Organization (WHO) criteria:²³ underweight <18.5kg/m², healthy

weight range 18.5-24.9kg/m², overweight $\geq$ 25kg/m², or obese $\geq$ 30kg/m². Age-adjusted healthy weight for elderly (>65 years) was defined as BMI 22-27kg/m² for 19 participants.²⁴ Fat-free mass index (FFMI) was calculated by dividing FFM by the square of height (metres). Cut off points of 16kg/m² for males and 15kg/m² for females defined FFM depletion.^{8,11}

Food intake was assessed using a validated Food Frequency Questionnaire (FFQ).²⁵ Food data were analysed by defining food groups and converting grams per day into serves for each category, which were then compared to the Australian Dietary Guidelines for adequacy.²² In the absence of specific dietary recommendations for individuals with COPD, these guidelines were used. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommendations for older people at risk of malnutrition due to illness were used for protein intake (1.2-1.5g/kg/day).²⁶

A face-to-face semi-structured interview was conducted with each participant and focused on personal definitions of healthy eating, cooking and eating behaviours, influences on food choice and lifestyle, ideas about changing eating patterns and barriers to healthier dietary habits. Open-ended interview questions were developed from examination of the literature (Appendix 1). All interviews were conducted by a single researcher (N.S.) and responses were recorded and transcribed verbatim.

Shortness of breath and disability were assessed using the Modified Medical Research Council (MMRC) dyspnoea scale.²⁷ Mood was assessed using the Hospital Anxiety and Depression Scale (HADS).²⁸ Scores were categorised for self-reported levels of anxiety and depression as: normal 0-7, mild 8-10, moderate 11-14, and severe 15-21.²⁹

Data collected from medical records and at interview included presence of co-morbidities, use of home oxygen, most recent post-bronchodilator FEV₁, FVC and FEV₁/FVC ratio. Spirometry was evaluated with standardised techniques using MGC Diagnostics equipment (Saint Paul, USA). Reference values were obtained from the third National Health and Nutrition Survey equations³⁰ with extrapolation for those aged greater than 80 years. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria were used to categorise severity of COPD: Stage I mild- FEV₁ ≥ 80%, Stage II moderate- 50% ≤ FEV₁ < 80%, Stage III severe- 30% ≤ FEV₁ < 50%, and Stage IV very severe- FEV₁ < 30%.³¹ Other demographic information gathered from participants included self-reported smoking status, education level, income source and amount, and living situation.

Quantitative data were analysed using SPSS for Windows v22.0TM (SPSS Inc., Chicago, USA). Participant characteristics are reported using mean ± standard deviation (SD) for normally distributed data, and median, IQR for non-parametric variables. Categorical variables are presented as frequency and percentage. Independent t-tests and Mann-Whitney tests were used to compare parametric and non-parametric continuous variables, respectively, between males and females. A One-Way Analysis of Variance (ANOVA) was used to test for statistical significance for continuous variables across BMI and age categories (<65 years, 66-74 years and ≥75 years). Qualitative responses were coded and interpreted by two investigators (N.S. and S.K.) both manually and utilising NVIVO (Version 10, Melbourne, Australia) to triangulate data. Common topics were aligned using thematic analysis to devise descriptive codes

representing the data and to develop key themes relating to nutritional status, eating patterns and food choices. Themes were discussed until a consensus was reached.

Results

Fifteen males and fifteen females participated (range 45-87 years). Age, anthropometric and clinical data are shown in Table 1. There were no significant differences between genders for these analyses.

Three-quarters of participants were solely reliant on a disability support or aged pension as their source of income. Eighty-eight percent of participants fell below the Australian threshold for low income.³² Almost half had not completed high school (40%). Forty-three percent of participants lived alone, with the remainder residing with family (54%) or friends (3%). Grocery shopping was done by council support services (13%) or with assistance from others (43%), whilst 44% were able to shop independently. Over half (53%) of respondents cooked for themselves, 37% had assistance from others and 10% received home-delivered meals.

Four (13%) participants were classified as underweight, sixteen (53%) were within a healthy weight range, five (17%) were overweight and five (17%) were obese. BMI distribution was similar between males and females (data not shown). Twenty-five participants (86%) had a waist circumference greater than NHMRC recommendations.²² FFMI was indicative of FFM depletion in eight participants (31%). Anthropometric variables, including FFMI, did not differ significantly across age groups ($p>0.05$); nor was there a significant association between FFMI and BMI (data not shown). Of

participants with low FFMI, four were underweight, five were within their healthy weight range, one was overweight and two were obese, confirming the occurrence of hidden FFM depletion shown by others.¹¹

Seventy-five percent of underweight participants were classified as GOLD stage II and 75% of obese participants had GOLD stage IV. There were no significant correlations between GOLD criteria and BMI or FFMI (data not shown). FEV₁ was the only variable that differed significantly between participants aged ≥ 65 years (30.8%) compared with those aged 66-74 years (52.2%) ($p=0.02$). Sixty-seven percent of participants were ex-smokers, 6% never smoked and 27% were current smokers. Seven percent required continuous oxygen and 30% required exertional oxygen use. Common co-morbidities included hypertension ($n=10$), dyslipidaemia ($n=7$) and gastro-oesophageal reflux disease ($n=6$). Two participants had type 2 diabetes mellitus. The self-reported mood scale (HADS) indicated anxiety in 40% of participants and depression in 27%. Dyspnoea ratings, as measured by MMRC, indicated moderate breathing impairment.²⁷

Table 2 compares average macronutrient intakes to Nutrient Reference Value (NRV) recommendations for Australia and New Zealand,²⁴ and ESPEN guidelines on protein consumption.²⁶ No significant differences were observed in energy consumption across the different BMI and categories (data not shown). Mean energy intake was at the lower end of the recommended range and protein intake was below recommendations.

Table 3 compares average servings per day consumed from each food group to Australian Dietary Guideline recommendations.²² This showed inadequate consumption

of dairy, fruit and vegetables, with fibre intakes below NRV recommendations. Mean energy consumption was at the lower end of the recommended range. Intakes of breads and cereals were adequate based on FFQ responses. Average protein intakes were below ESPEN recommendations, consistent with dairy, meat, fish and chicken consumption being inadequate or at the lower ends of the recommended ranges.

Analysis of interview transcripts revealed a range of common themes relating to disability associated with COPD, food habits and dietary intake, as displayed in Table 4 and discussed below.

The majority of respondents reported COPD as a debilitating illness that prevented them participating in daily activities. Shortness of breath and fatigue were identified as limiting physical capacity as well as influencing nutritional intake. For example one participant stated:

“So that’s the thing about breathlessness, it’s very hard to eat when you’re breathless.” (P78928)

Some reported needing to rest during food preparation and thus mentioned the need to plan and prepare meals early in the day. Fatigue also contributed to difficulty with or motivation for preparing meals and relying on foods that were convenient:

“So that tiredness is a factor that you have to think ahead to have food that can be produced very quickly, otherwise I eat more sandwiches.” (P78928)

Energy saving techniques included purchasing frozen meals, cooking food in bulk to be consumed at more than one meal, having home delivered meal services or relying on basic staples, such as canned soup or sandwiches:

“I used to cook for myself, and it was a lot fresher and tastier, now I get my meals through [home delivered meal provider]. And even though they’re not too bad, they’re not as nice as cooking for yourself.” (P78933)

Fatigue and reduced activity due to breathlessness resulted in early satiety, especially when unwell:

“It’s more like my stomach saying I don’t want it, that kind of sensation. I just feel it’s enough and put it away. So now, I eat slower and I’m eating less. I know I’m eating less at the time I’m doing all this because I’m more tired. And sometimes I’ll start off actually with the meal and eating it, and I just somehow can’t eat it... you know, it’s just too much, it won’t go down, I haven’t gotten the appetite and it’s somehow too exhausting. Like trying to carry a weight that’s too heavy.” (P78928)

Some participants attributed swallowing issues to medication side-effects, such as dry mouth and metallic taste:

“I do have a bit of a swallowing problem these days, which may be from all those years of sucking in medication; and that’s the reason for eating more slowly and with smaller amounts.” (P78928)

Participants living alone or with limited support reported reduced desire or energy to prepare meals. Many respondents who had supportive friends or family relied on this assistance to complete daily shopping and cooking tasks. Being with others was also cited as making cooking more appealing and improving the mealtime experience:

“If you’re alone and you’re not feeling well you’re not inclined to do it. Whereas if there was someone else around and you were cooking for somebody else, obviously you’d make the effort.” (P78929)

Financial circumstances were not reported as a barrier to purchasing food, despite many of the study cohort having a low income. Many respondents reported being vigilant about prices, but that quality or freshness were important:

“Cheapness, quality is important to me. So I won’t just get cheap food just because they’re cheap. I like the quality as well as the cost.” (P78937)

“No, price doesn’t come into it anymore. It used to but not anymore it doesn’t. I buy what I want.” (P83670)

Some respondents made an attempt not to let their illness affect their mood and tried to remain positive. Others felt that being unable to do activities that they enjoyed as frustrating and occasionally isolating:

“Yeah it’s dramatically changed my life. Having COPD it’s made my quality of life a lot less, I’ve lost a lot of weight ... I don’t eat as well, I suffer from depression as well.” (P78933)

Another respondent spoke of eating out of.... *“boredom (and feelings of) disappointment. Have to fill up the hole, that’s a big one”.* (P78927)

Many respondents reported healthy eating as important to their health; however, habit or motivation were the main factors contributing to what they ate:

“I’m not seeing it as being important I just do it automatically. Just something which is in my body and my nature does. (It’s) never been (a priority). It’s just a habit.” (P78937)

Most participants described healthy eating in the context of general health rather than nutrition priorities or any specific dietary recommendations relating to COPD:

“I think (COPD has) had an impact, it’s making me think about healthier options. But I believe that’s because of the weight I’m carrying. It’s not the illness, it’s just uncomfortable being fat.” (P78944)

Amongst the overweight/ obese participants, knowledge about energy balance appeared limited. Only two participants discussed food intake in relation to physical activity levels and medication side-effects:

“The weight is a lot to do with the medications and no exercise. Because I can’t breathe, I can’t get up and walk around and do exercises, hence the weight.” (P78943)

Participants reported consumption of fruits and vegetables and reducing intake of fat and sugar as being important to follow a healthy diet. A common theme that emerged related to meeting basic food groups and simplifying food choices:

I would describe a healthy diet as “rather old fashioned, but I think meat and three vegetables.” (P78941)

“I’m sure healthy eating does (have benefits). Well I think if you get sick and your general health is good, well you have better capabilities of fighting it off.” (P83669)

Many respondents indicated that a prescribed meal plan or home cooked meals would be their preferred intervention to improve nutritional status:

“The easiest way I think you could help me would be to sit down and work out a Monday to Friday; that’s your diet for the week. Like you do in the hospital wards... That would be the best thing for me... it’s more about a prescribed diet.” (P78939)

Interviews also revealed desire for a personalised approach to nutrition support and dietetic intervention, underpinning the importance of access to individual consultations and support from professionals with nutrition expertise:

“The dietitian... checking and asking us what we eat and giving us healthy tips on what is good and bad for us and also ensuring that we have a product called xxx to drink to help also with our diets.” (P78933)

Discussion

This qualitative study explored influences on food intake and eating habits in a cohort of adults with COPD undertaking pulmonary rehabilitation. Common barriers to healthy eating included limited social support, loss of appetite, and physical restrictions such as breathlessness, swallowing problems and fatigue; whereas enablers included support from others for shopping and cooking, and company at mealtimes. This area has not been well studied in COPD to date and thus our results provide an important contribution to understanding nutrition challenges faced by people in this group. The sample size of 30 participants was chosen to allow range of age, gender and

demographic characteristics, to explore a variety of experiences and attitudes about food and nutrition. This qualitative study did not aim to be powered to undertake quantitative assessment of associations between nutrient-related variables and other issues, such as anxiety, depression or BMI, which would require a larger epidemiological study.

Studies in the general older population report that attitudes and beliefs underlying food choices originate from an individual's sense of personal identity including ethnicity, social status, age, living arrangements, marital status and gender.³³ Older age is linked to food choices being based on familiarity, health, cooking skills and mood.³³ The current study found similar issues with debility from illness and social support being amongst the most significant factors impacting an individual's nutritional intake, as measured by assessing quality of life (via administration of HADS).²⁹

No participant specifically referred to loss of muscle mass or strength in their interview although reports of fatigue and debility were common. Given the association between declining nutritional status and increased mortality in COPD,¹¹ more attention may need to be given to assessing and educating patients on body composition and implementing strategies to minimise loss of muscle mass. Our findings highlight the importance of early surveillance systems to identify COPD patients who might be at risk of nutrition decline and FFM loss related to inadequate dietary intake.

The intakes of several food groups (dairy, fruit and vegetables) in this study population were below recommendations, which is consistent with other studies.⁶ This may be due to adaptations from reduced appetite resulting in choosing smaller portions, limited access to fresh produce, food preferences, cost or chewing issues.³⁴ While the

focus of most intervention studies in COPD has been on energy and protein intakes and addressing weight status and body composition, there is evidence emerging that diet quality may be important for disease progression.^{12,35} Consuming higher intakes of fruit and vegetables to increase antioxidant intakes (vitamins C and E) showed a benefit in FEV₁% predicted in a randomised controlled trial.³⁶ To this effect, further research on interventions that improve diet quality and nutrient density in managing the clinical course of COPD, are required.

Brug *et al.*³⁷ suggest that approaches to improve dietary intake should involve a combination of nutrition support, education and self-management principles, key aspects of which include gaining insight into the barriers that impact achieving adequate dietary intake. Our findings suggest a need for individualized care to increase understanding about the impact of nutrition on COPD, as well as incorporating motivational interviewing and coaching strategies to overcome barriers and optimise nutritional status and health outcomes.

The findings of this study support the process of early identification and assessment of COPD patients at risk for malnutrition, those who are overweight/ obese and those with sarcopenia. Anthropometric and body composition tools, together with investigations regarding finances, support networks and physical limitations that impact dietary habits and food quality may assist in delivering targeted and effective nutrition interventions. Referral to a dietitian should occur early in the disease process. Clinicians should investigate further social connections and support for shopping and cooking in order to coordinate services that will assist to improve nutritional status. Effective

interventions by interdisciplinary clinicians should incorporate personalised messages that actively engage the consumer and/ or their care-giver and are within their agreed upon capacity whilst being simple, effective and require minimal effort and cost.³³ As these needs change with age and disease severity, regular nutrition reviews should be employed to maximise a person's capacity to make positive adaptations and minimise the detrimental effects of poor nutrition.

This study has a number of strengths including utilising a multi-methodological approach. Qualitative research is valuable for deeper understanding of subjective experiences. Quantitative data aided in categorising the in-depth qualitative data to shape identified themes,³⁸ permitting a deeper analysis of attitudes, beliefs and feelings which lie behind quantitative data.³⁴

Study recruitment took place during active participation in pulmonary rehabilitation which may limit its generalisability across the COPD spectrum. This may result in selection of patients who are more motivated to improve their health. However, the sickest and most severely debilitated by this illness may have been under-represented and they may have different issues affecting their health and nutrition. Findings cannot be generalised to home-bound individuals and those residing in residential care who have reduced autonomy over food choices.

This study uncovered the following common themes influencing nutrition intake and eating patterns in a stable COPD sample: debility from illness and medication side-effects, disease symptoms such as shortness of breath, fatigue and reduced appetite, social supports, lack of nutrition knowledge in the context of COPD, and motivational

factors. Approaches to improving nutrition status and changing eating behaviours should take into account self-perceived enablers and barriers to food selection in order to be effective. This study underscores the importance of tailoring nutrition intervention and education to people with COPD on an individual basis together with early intervention and screening to identify aspects of nutrition impacting on function, quality of life and morbidity.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

Authorship declaration

All authors were involved in conception of study design and critical review of the completed manuscript. NS was principal investigator and undertook literature searching, participant interviews, data collection, analysis of results and manuscript write up. SK undertook literature searching, analysed qualitative data, undertook thematic analysis and manuscript write up. AT assisted in statistical analysis.

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Appendix 1

Semi Structured Interview

Note: Only the core interview questions are included here. Additional probing was utilised when/ as required.

1. Tell me about your health.
2. Tell me about how you feel since being diagnosed with COPD.
3. How do you think having lung disease influences your life?
4. Have you had to change what you eat since being diagnosed with a lung disease?
Why did you make that change?
5. Do you think your health has an impact on what you eat? If so, in what way? Can you describe to me how it impacts on your eating?
6. How would you describe a healthy diet?
7. Do you think that healthy eating will have any benefits for you? Why, why not?
8. How important is it to you to follow a healthy diet? How important do you think food is to health?
9. What are the reasons that you choose to eat the foods that you eat?
10. How do you feel about shopping for food?
11. What influences your food purchases when you are at the supermarket?
12. How would you rate your skills in being able to prepare a meal?

13. What influence does your family or friends make to your diet? Describe to me how the people you live with influence your food choices? **OR** Does eating alone impact on your eating?
14. Can you describe to me any physical feelings that you may experience when you eat?
15. What would help you to eat a healthier diet?

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