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Title: Relationships between nutritional knowledge, obesity, and sleep disorder severity.

Short title: Nutrition knowledge, obesity and sleep disorders.

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SUMMARY

Obstructive sleep apnoea affects 20% of the adult population. Weight control is considered the best non-medical means of managing the condition, therefore improving nutritional knowledge in individuals may be an appropriate strategy. This study aimed to describe the relationship between nutritional knowledge and: i) sleep disorder severity; ii) body mass index; and iii) demographic characteristics in persons suspected of obstructive sleep apnoea. Nutrition knowledge scores were also compared to the general population. Consecutive newly-referred patients attending the sleep laboratory for diagnostic polysomnography were invited to participate. Those who consented (n=97) were asked to complete a touchscreen survey. Apnoea-hypnoea index to measure sleep disorder severity and anthropometric measurements were obtained from the clinic. A quarter of participants were diagnosed with severe obstructive sleep apnoea; and a majority (88%) were classed as being overweight or obese. Overall mean nutrition knowledge score was 58.4 ± 11.6 (out of 93). Nutrition knowledge was not associated with sleep disorder severity, body mass index or gender. The only significant difference detected was in relation to age, with older (≥ 35 years) participants demonstrating greater knowledge in the 'food choices' domain compared to their younger counterparts (18-34 years; $p < 0.030$). Knowledge scores were similar to the general population. The findings suggest that nutrition knowledge alone is not an important target for weight control interventions for people with obstructive sleep apnoea. However, given the complexities of sleep disorders, it may complement other strategies.

Keywords: Body Mass Index; Obstructive Sleep Apnoea; Nutrition; Sleep Disordered Breathing.

INTRODUCTION

An increasing proportion of Australian adults are either overweight or obese, representing 62.8% of the population (Australian Bureau of Statistics 2013). Overweight and obesity are known to have a strong causal links with obstructive sleep apnoea (OSA) which is estimated to affect around 20% of the adult population (Young et al. 2002). The condition is characterised by repetitive collapse of the upper airway during sleep. This causes frequent arousals and poor quality sleep resulting in daytime hypersomnolence and other neurocognitive deficiencies, and is associated with increased risk of mortality (Marshall et al. 2008).

Whilst body weight increases are related to worsening OSA, the converse is also true in that weight loss may decrease the severity of this condition (Young et al. 2002). Weight control is therefore considered as the best non-medical means of treating or managing OSA in the clinical setting, and also provides other benefits from a public health perspective (Young et al. 2002). Despite this, the limited literature describing lifestyle modification to achieve sustained weight loss in OSA patients has been largely disappointing (Schneerson et al. 2001, Romero-Corral et al. 2010). Of studies investigating such approaches to improve OSA outcomes, interventions of greater success have commonly incorporated elements of very low caloric diets (Yee et al. 2007, Tuomilehto et al. 2009). Individual dietary and behavioural counselling has also been shown to have promising results (Fujii et al. 2010). Whilst surgical approaches can be effective (Dixon et al. 2012), it is not widely accessible and the most effective approach for achieving long-term, sustained weight loss for people with OSA is not clear.

Both theoretical models and frameworks of behaviour change (Ajzen 1991, Michie et al. 2011) and the empirical literature (Baranowski et al. 2003) suggest that relevant knowledge can have a small but important role in achieving behavioural outcomes such as weight loss or maintenance. While little is known about nutrition knowledge among OSA patients, in some populations such as the socially disadvantaged, nutrition knowledge has been found to be poorer and a mediating factor for diet quality (McLeod et al. 2011). In line with the expectation that increasing nutrition knowledge can assist in changing dietary behaviour (Hendrie et al. 2008), nutrition education may play a role in achieving weight loss.

Potential links between overweight/obesity and nutrition knowledge have not been explored in OSA patients. Given this, the study aimed to identify in people with suspected sleep disorders whether level of nutrition knowledge:

- i. Is lower than that of the general population;
- ii. Is associated with demographic characteristics such as age and gender;
- iii. Is positively associated with body mass index; and

- iv. Is positively associated with severity of sleep disordered breathing and whether educational level influences this relationship.

METHODS

Setting

This cross-sectional study was undertaken at the Newcastle Sleep Disorders Service, in NSW Australia. Ethical approval was provided by the University of Newcastle (H-2012-0346) and the Hunter New England Area Health Service (12/09/19/5.10) Human Research Ethics Committees.

Study sample

Within the Australian healthcare setting, patients suspected of sleep disorders are referred to specialist testing by their primary care physician. Consecutive newly-referred patients attending the sleep laboratory for diagnostic polysomnography (PSG) were invited to participate. Individuals aged 18 years or older, literate in English, and capable of completing the questionnaire were eligible to participate. Exclusion criteria were previous formal diagnosis of any sleep disorder or organic neurological or neurocognitive abnormality.

Procedure

Participants were recruited as they arrived at the sleep laboratory for overnight diagnostic PSG. Informed written consent was obtained from participants, who were asked to complete self-administered questionnaires using touchscreen computers, after which participants underwent PSG in the usual manner (Hensley et al. 2005) using a computerised PSG system (E-series, Compumedics Ltd., Abbotsford, Australia). PSGs were analysed and scored in accordance with AASM_{alt} rules (Iber et al. 2007), and scorers were blinded to questionnaire results. If participants were unable or unwilling to complete the study, the questionnaire was abandoned and this was documented.

Measured variables

Anthropometric. Body weight, height, waist and neck circumference were measured by trained staff at the time of recruitment. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared and grouped into five categories: underweight (BMI <18.5); normal (BMI 18.5-24.9); overweight (BMI 25-29.9); obese class I (BMI 30-34.9); and obese class II (BMI ≥35).

Apnoea-hypopnoea index (AHI). AHI was used to assess severity of sleep-related breathing disturbance and was calculated by dividing the number of apnoeas and hypopnoeas by the number of hours of sleep. Mild disturbance was defined as AHI of 5.0-14.9, moderate as AHI of 14.9-29.9 and severe as AHI ≥ 30.0 events per hour.

Self-reported variables

The touchscreen survey included the following items:

Sociodemographic characteristics. Participants were asked items relating to age, gender, marital status, level of education, employment status and access to a healthcare card.

Nutrition knowledge. Ninety-three items from the Australian version (Hendrie et al. 2008) of the General Nutrition Knowledge Questionnaire (GNKQ) (Parmenter et al. 1999) were used. These items covered three areas of nutrition knowledge: i) knowledge of dietary recommendations (13 items, possible score 0-13); ii) sources of nutrients (70 items, possible score 0-70); and iii) choosing everyday foods (10 items, possible score 0-10). Responses were given using a range of scales including “more, same, less, don’t know”, “yes, no, not sure”, “high, low, not sure”, “agree, disagree, not sure” or a choice of four different food options. Correct responses within each area were calculated to provide a section score, and the combined score of all three sections gave a total score out of 93. A higher score indicates greater nutrition knowledge.

Statistical analysis

Data were analysed using Stata software (Version 11, StataCorp, Texas, USA). Nutrition knowledge, anthropometric and AHI data were normally distributed. Pearson correlations were used to identify associations between variables and differences between groups were examined using independent sample Student t-tests.

RESULTS

Figure 1 illustrates the process of participant recruitment and survey completion. Of the 146 eligible individuals approached, 101 consented to participate (consent rate of 69.2%). The most common reason for ineligibility was not presenting for diagnostic PSG (n=249, 95.4%). The predominant reason for invitees declining participation was lack of interest (n=23), followed by low computer literacy (n=12). Females were more likely than males to refuse participation. Of those who commenced the questionnaires, 4 withdrew before completion, leaving a total of 97 participants completing the study. Demographic characteristics, diagnostic PSG and BMI data for all participants are shown in Table 1.

[INSERT FIGURE 1 ABOUT HERE]

[INSERT TABLE 1 ABOUT HERE]

For the entire sample, overall mean score on nutrition knowledge was 58.4 (SD, 11.6). Mean scores on each of the subscales were 8.1 (SD, 1.8) for dietary recommendations, 44.3 (SD, 9.4) for food nutrients, and 6.0 (SD, 2.1) for food choices.

In all areas, no significant differences were detected between the sexes ($p=0.302$; Figure 2). Significant differences were observed when subjects were dichotomised into younger (18-34 years) or older (≥ 35 years) groups ($p<0.030$; Figure 3).

[INSERT FIGURE 2 ABOUT HERE]

[INSERT FIGURE 3 ABOUT HERE]

Findings did not support any significant relationship between overall nutrition knowledge score and BMI ($r=0.046$, $p=0.650$). Similarly, there was no significant correlation between nutrition knowledge and other markers of overweight measured, namely waist and neck circumference (data not shown). Separating the nutrition questionnaire data into the 3 separate domains of nutrition knowledge revealed a single significant relationship between BMI and everyday food choice knowledge ($r=0.204$, $p=0.027$).

No significant relationships could be found between nutrition knowledge and severity of sleep-disordered breathing, when expressed as AHI ($r=0.143$, $p=0.172$). While there was no statistically significant difference in overall nutritional knowledge scores when participants' scores were grouped by highest educational level achieved ($p=0.762$), those with highest qualifications tended to have higher nutrition knowledge scores: mean scores were 60% (SD, 12.0), 63% (SD, 14.0) and 70% (SD, 8.5) for high school level, technical or trade qualification level and university level respectively.

DISCUSSION

These data indicate that there is no systematic relationship between knowledge of nutrition and obesity or sleep disordered breathing severity in subjects attending a clinical sleep laboratory for investigation of possible sleep disorders. Furthermore, these data also show that nutrition knowledge in this group with a very high rate of overweight and obesity does not appear to be substantially different from that of the general Australian population (Hendrie et al. 2008). These findings suggest that obesity and the consequent effects on severity of sleep-disordered breathing are not fundamentally caused by a lack of nutritional knowledge.

It is tempting to ascribe high community rates of obesity and sleep disorders such as obstructive sleep apnoea on lack of knowledge of nutritional fundamentals. There is evidence that nutritional education campaigns can result in measurable improvements in eating behaviours, such as that demonstrated in the Western Australian 'Go for 2 & 5' campaign to improve fruit and vegetable consumption (Pollard et al. 2008). The conclusion that improving knowledge of nutrition can improve health outcomes therefore seems logical. However the causes of obesity are multifaceted and there are likely to be

many factors contributing to the development and maintenance of an individual's obesity. Not surprisingly, our data indicates that nutritional knowledge alone provides little explanation for the incidence of obesity and sleep disordered breathing. We were surprised however to find little evidence of any relationships between nutrition knowledge and body weight.

Similarly to that previously reported (Hendrie et al. 2008), we found that younger participants had lower nutrition knowledge. Whilst we also found that females tended to score higher in nutritional knowledge than males, this difference did not reach significance and was not as marked as that previously described (Hendrie et al. 2008). Our data showed a trend towards higher nutritional knowledge scores in those higher educational level, also in line with that previously reported (Hendrie et al. 2008).

On analysis of the specific domains of nutrition knowledge, the only significant correlation with BMI was found with knowledge of healthy food choices. It is noteworthy that this aspect of nutrition knowledge scored numerically lower than other domains, particularly in the younger age group (Figure 3). These data suggest that this important aspect of daily lifestyle choice may play an important role in healthy weight control and suggests a specific focus that educational initiatives could be directed towards.

The evidence for a causal link between obesity and sleep-related breathing disorders, particularly OSA, is compelling and as such weight loss is recommended as part of a treatment strategy for all overweight OSA patients (Epstein et al. 2009). However the most effective method for achieving weight loss in OSA is not clear.

The data suggests there is little need to focus on nutrition knowledge in weight loss interventions for OSA patients, although there may still be some OSA-specific knowledge that may assist with choices and motivation. It is important to acknowledge that OSA is complex, and treatment cannot be focused towards a particular symptom or feature of the condition. While weight loss has been shown to be beneficial in mitigating the effects of OSA, it is notably difficult to maintain long-term results. Therefore, it may be that efforts need to be directed towards multi-disciplinary approaches which enable patients to make healthy food choices. This could involve appropriate therapy use and adherence, open patient-provider communications and continued follow-ups or patient monitoring in addition to promoting lifestyle modification strategies (Romero-Corral et al. 2010). To our knowledge no such programs have been described for the management of sleep disorders, and whilst the efficacy of individual approaches has not been adequately demonstrated (Schneerson et al. 2001), the effectiveness of a multidimensional approach may be worthy of investigation.

Conclusion

Nutritional knowledge in patients presenting to a sleep laboratory does not appear to be any worse than the general Australian community and there are no strong relationships between nutritional knowledge and obesity or sleep disorder severity. These data suggest that providing education to improve knowledge of diet and nutrition is not a critical component of interventions for achieving weight loss for the management of sleep disordered breathing.

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REFERENCES

- Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 1991; 50: 179-211.
- Australian Bureau of Statistics. Overweight and obesity. 2013. Canberra, ABS.
- Baranowski, T., Cullen, K. W., Nicklas, T., Thompson, D. and Baranowski, J. Are current health behavioral change models helpful in guiding prevention of weight gain efforts? *Obes. Res.* 2003; 11: 23S-43S.
- Dixon, J. B., Schachter, L. M., O'Brien, P. E., et al. Surgical vs conventional therapy for weight loss treatment of obstructive sleep apnea: a randomized controlled trial. *JAMA : the journal of the American Medical Association* 2012; 308: 1142-1149.
- Epstein, L. J., Kristo, D., Strollo, P. J., Jr., et al. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. *J. Clin. Sleep Med.* 2009; 5: 263-276.
- Fujii, H., Miyamoto, M., Miyamoto, T. and Muto, T. Weight loss approach during routine follow-up is effective for obstructive sleep apnea hypopnea syndrome subjects receiving nasal continuous positive airway pressure treatment. *Ind. Health* 2010; 48: 511-516.
- Hendrie, G. A., Coveney, J. and Cox, D. Exploring nutrition knowledge and the demographic variation in knowledge levels in an Australian community sample. *Public Health Nutr.* 2008; 11: 1365-1371.
- Hendrie, G. A., Cox, D. N. and Coveney, J. Validation of the general nutrition knowledge questionnaire in an Australian community sample. *Nutrition and Dietetics* 2008; 65: 72-77.
- Hensley, M., Hillman, D., McEvoy, R., et al. Guidelines for sleep studies in adults. The Australasian Sleep Association & Thoracic Society of Australia and New Zealand,. 2005. Sydney.

- Iber, C., Ancoli-Israel, S., Chesson, A. and Quan, S. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications. 2007. Westchester: IL, American Academy of Sleep Medicine.
- Marshall, N. S., Wong, K. K., Liu, P. Y., Cullen, S. R., Knuiman, M. W. and Grunstein, R. R. Sleep apnea as an independent risk factor for all-cause mortality: the Busselton Health Study. *Sleep* 2008; 31: 1079-1085.
- McLeod, E. R., Campbell, K. J. and Hesketh, K. D. Nutrition knowledge: a mediator between socioeconomic position and diet quality in Australian first-time mothers. *J. Am. Diet. Assoc.* 2011; 111: 696-704.
- Michie, S., van Stralen, M. M. and West, R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement. Sci.* 2011; 6: 42.
- Parmenter, K. and Wardle, J. Development of a general nutrition knowledge questionnaire for adults. *Eur. J. Clin. Nutr.* 1999; 53: 298-308.
- Pollard, C. M., Miller, M. R., Daly, A. M., et al. Increasing fruit and vegetable consumption: success of the Western Australian Go for 2&5 campaign. *Public Health Nutr.* 2008; 11: 314-320.
- Romero-Corral, A., Caples, S. M., Lopez-Jimenez, F. and Somers, V. K. Interactions between obesity and obstructive sleep apnea: implications for treatment. *Chest* 2010; 137: 711-719.
- Schneerson, J. and Wright, J. J. Lifestyle modification for obstructive sleep apnoea. *Cochrane Database Syst. Rev.* 2001.
- Tuomilehto, H. P., Seppa, J. M., Partinen, M. M., et al. Lifestyle intervention with weight reduction: first-line treatment in mild obstructive sleep apnea. *Am. J. Respir. Crit. Care Med.* 2009; 179: 320-327.
- Yee, B., Phillips, C., Banerjee, D., Caterson, I., Hedner, J. A. and Grunstein, R. The effect of sibutramine-assisted weight loss in men with obstructive sleep apnoea. *Int. J. Obes.* 2007; 31: 161-168.
- Young, T., Peppard, P. E. and Gottlieb, D. J. Epidemiology of obstructive sleep apnea: a population health perspective. *Am. J. Respir. Crit. Care Med.* 2002; 165: 1217-1239.

Table 1: Baseline demographic and diagnostic sleep study data.

	Female (n=58)	Male (n=39)	Both (n=97)
Mean ± SD			
Age, yrs	49.6 ± 15.2	50.3 ± 17.7	49.9±16.2
BMI, kg/m ²	34.0 ± 9.0	35.6 ± 9.2	34.6 ± 9.0
Weight, kg	90.9 ± 24.5	110.5 ± 31.5	98.8 ± 28.9
Waist, cm	105.5 ± 21.6	117.3 ± 25.7	110.2 ± 23.9
Neck, cm	38.4 ± 8.6	44.9 ± 9.6	41.0 ± 9.5
AHI, events/hr	16.6 ± 21.8	29.9 ± 29.9	21.9 ± 26.0
n (%)			
BMI, kg/m ²			
Underweight (<18.5)	0 (0%)	0 (0%)	0 (0%)
Normal (18.5-24.9)	11 (19%)	1 (3%)	12 (12%)
Overweight (25-29.9)	10 (17%)	11 (28%)	21 (22%)
Obese class I (30-34.9)	11 (19%)	12 (31%)	23 (24%)
Obese class II (≥35)	26 (45%)	15 (38%)	41 (42%)
OSA Severity, AHI			
Normal (<5)	21 (36%)	6 (15%)	27 (28%)
Mild (5.0-14.9)	17 (29%)	12 (31%)	29 (30%)
Moderate (15-29.9)	11 (19%)	6 (15%)	17 (18%)
Severe (≥ 30.0)	9 (16%)	15 (39%)	24 (25%)
Highest Education Level			
< Year 10	15 (26%)	2 (5%)	17 (18%)
Year 10-12	18 (31%)	17 (44%)	35 (36%)
Tech. or trade qualification	16 (28%)	11 (28%)	27 (28%)
University degree	9 (16%)	9 (23%)	18 (19%)

Figure 1: Flowchart indicating numbers of participants involved at each stage of the study. See text for more details regarding reasons for non-participation.

Figure 2: Nutrition knowledge by sex (mean values).

Figure 3: Nutrition knowledge by age group (mean values).

* Significant differences between age groups in study sample (t-test, $p < 0.030$).