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Gender differences in the influence of food safety concerns on dietary and physical activity behaviours

Abstract

Objective: The purpose of the study was to examine middle aged Australians' dietary and physical activity behaviours and to investigate their relationships with their food safety concerns, body weight, demographics, and personal values (guiding principles in people's lives). **Methods**: A mail survey was conducted among a random sample of men and women aged between 38 and 79 years; 1095 usable questionnaires were obtained. Multi-group structural equation modelling was used to examine the relationships between the variables among men and women. **Results**: Food safety concerns played central roles in the relationships between demographics, body weight, personal values and dietary and physical activity habits for both men and women. However, there were significant differences between the genders in the ways the food safety concerns impacted these relationships. For example, body weight was negatively related to women's physical activity behaviours but not men's; the concerns were associated with eating out behaviours among women but not men; age influenced women's concerns and physical activity but not those of men. **Conclusions**: Men and women's dietary and physical activity habits were impacted directly by personal background characteristics, body weight, and personal values, and indirectly through the construct of food safety concerns. **Implications**: For food policy makers, a gendered focus on food safety concerns, and other relatively malleable variables such as personal values, may be more likely to change dietary and physical activity habits in the short term than a focus on more stable socio-demographic characteristics.

Key words: Food safety concerns, dietary and physical activity habits, personal values, survey, Australia

1. Introduction

One of the key issues in food policy is the response to the chronic disease epidemic (Popkin & Gordon-Larsen, 2004) in which dietary behaviours and physical activity play key causal roles (Curioni & Lourenco, 2005). Over the past three decades various models have been proposed to account for influences over these behaviours in order to identify ways to make them healthier. Public health investigators have noted the influence of structural factors such as social class (Marmot & Wilkinson, 2006), age and gender, which are often embedded within ecological models (Bronfenbrenner, 1992; Glass & McAtee, 2006; Hancock, 1993). Behaviourists, on the other hand, have emphasised 'downstream influences' such as attitudes, beliefs, self-efficacy and other cognitive constructs in several popular models (social cognitive model, theory of planned behaviour and other expectancy value models). Lately these models have been criticised, particularly with regard to dietary behaviours, for not accounting for non-cognitive factors such as affect and habit (Hamlin, 2010; Kahneman, 2011; Wansink, 2010).

The 'structural models' identify well the influence of stable, difficult to change factors (like social class) whilst the behavioural models may be too general and incomplete. In terms of food policy, it would be useful to identify intermediary variables between the structural factors and behaviours which could be altered in a fairly ready manner. The possible intermediaries are consumers' broad range of food and health concerns (e.g., food safety, food and disease). There has been a long history of academic interest in these issues. For example, Wandel and Bugge (1997) were among the first to report public perceptions of food

safety; and, Frewer and her colleagues have provided detailed accounts of consumers' worries about the safety of the food they eat (de Jonge et al., 2004; Fischer & Frewer, 2009a, 2009b). There is increasing evidence, however, that consumers have many other concerns about food in addition to its safety (Hughes, 2005; UK Cabinet Office, 2008). For example, many product labels carry 'credence logos' signifying environmental, fair trade, low-fat, or other supposed properties of the food product (Dunbar, 2010; McEachern, 2008; McEachern & Warnaby, 2008).

Several studies have shown that several types of concerns were held by consumers relating to safety and microbiological contamination, chemical additives, concern for animal welfare and less fortunate people, health outcomes, food marketing and promotion of 'junk' foods, and environmental issues (Hohl & Gaskell, 2008; Worsley & Lea, 2008; Worsley & Scott, 2000; Worsley & Skrzypiec, 1998). In these studies, older people, women, and those on lower incomes and with less education, tended to be more concerned about most of these issues. It was also shown that consumers who held strong universalist values (Schwartz, 1992) were more likely to be more concerned about most issues (Worsley & Lea, 2008). Universalist values have been shown to be related to humanist and ecological social ideologies (Lindeman & Sirelius, 2001).

Previous work (Beardsworth et al., 2002; Worsley & Scott, 2000) on food concerns has shown that they are related to structural or stable factors especially gender. Women are more aware of higher levels of threat and concern because they usually have more responsibility for complex decision-making in everyday food preparation and consumption (e.g., Socrates-Grundtvig, 2006). Therefore, men and women are likely to hold different perceptions about the risks posed by food.

In the present study, we examined food safety concerns reflected by six items (see Table 2). The aims of the study were

(1) To identify the role of food safety concerns as possible intermediaries between demographics, body weight, and personal values, and, dietary and physical activity habits;

(2) To examine whether the items measured food safety concerns, and dietary and physical activity habits in the same way across the gender groups; and,

(3) To assess whether the relationships between the predictor variables, food safety concerns, and dietary and physical activity habits were the same between the gender groups.

1.1 *Body Mass Index (BMI)*

People who are overweight or obese, probably find it difficult to control their health behaviours, may be exposed to more health risk factors, and may experience greater concern about food and health issues (Edwards, 2011; Marmot & Wilkinson, 2006).

1.2 *Demographics*

Older individuals tend to have different food consumption habits to younger people (Dean, Raats, Grunert, Lumbers, & The Food in Later Life Team, 2009; McKie, 1999). Generally older people, with their greater morbidity (Australian Institute of Health and Welfare, 2007), may be more likely to experience greater concerns about the effects of food on their health. Women tend to choose more nutritious foods than men and generally are more concerned about health and food issues (Beardsworth, et al., 2002; Worsley, 1988; Worsley & Scott, 2000; Worsley & Skrzypiec, 1997, 1998). People from lower socio-economic status (SES) backgrounds tend to consume more energy dense foods (Drewnowski & Specter, 2004; Turrell, Hewitt, Patterson, Oldenburg, & Gould, 2002; Worsley, Blasche, Ball, & Crawford,

2003; Worsley, Blasche, Ball, & Crawford, 2004) though in some circumstance they may choose highly nutritious food (Cole-Hamilton & Lang, 1986). In addition, the food behaviour of married people tends to be more consistent with the dietary guidelines (Roos, Lahelma, Virtanen, Prattala, & Pietinen, 1998). Therefore, we hypothesized, that gender, age, education, family income and marital status would be strongly associated with food safety concerns, and subsequently, to dietary and physical activity habits. In general, we expected the demographic differences observed in food consumption studies to be reflected in concerns about food and health issues.

1.3 *Personal values*

Personal values are considered to be at the centre of attitude-behaviour models (Feather, 1982) which have been shown to predict food consumption (Grunert & Juhl, 1995; Povey, Conner, Sparks, James, & Shepherd, 2000; Sparks, Hedderley, & Shepherd, 1992). There is considerable evidence that personal values are related to food choice (Allen & Baines, 2002; Feather, Norman, & Worsley, 1998), to the practice of vegetarian diets (Allen & Baines, 2002; Sims, 1978), food concerns (Worsley & Lea, 2008; Worsley & Scott, 2000), support for school food policies (Worsley, 2006), and to trust in sources of nutrition information (Worsley & Lea, 2003), as well as purchasing decisions (Belk, 1983; Belk, 1985). Therefore, we expected values like universalism and conformity (Schwartz, 1992) to be positively related to food safety concerns, and dietary and physical activity habits. Universalism reflects the values of understanding, appreciation, tolerance, and protection for the welfare of all people and for the nature (Schwartz, 1992). Conformity values tend to be positively related to universalism; they reflect the characteristics of tradition, self-discipline, honouring of parents and elders, and obedience.

1.4 *Food safety concerns*

Finally, we hypothesised that people who have concerns about food and health issues (perceive more dangers posed by foods; Bedford & Barr, 2005) will be more likely to attempt to control their eating habits, for example, by eating reduced portion sizes and controlling their energy intake. We also expected that they would engage more often in physical activity than those who were less concerned about these health issues, because physical activity is a popular way to safeguard health.

2. Methods

The findings reported here are based on data from middle-aged Australian survey, a random population survey among 38 to 79 year olds living in Victoria, Australia. This survey was one of a series of studies of middle aged people's food and health behaviours (e.g., Hunter & Worsley, 2009; Wang, Worsley, & Cunningham, 2009; Worsley, Wang, & Hunter, 2010).

2.1 Participants

The survey was administered to a simple random sample drawn from the Electoral Rolls, Victoria, Australia. Enrolment is compulsory for everyone over 18 years of age. Two thousand four hundred and seventy two people aged over 35 years were invited to participate in 2008, of whom 1095 returned completed questionnaires, indicating a reasonable response rate of 44.3% for this mail survey (Dillman, 2009).

2.2 Procedure

The survey was mailed to the sample following the procedures recommended by Dillman (2009). First, a preparatory letter was sent followed a week later by the questionnaire along with an explanatory letter; two weeks later a reminder postcard, and two weeks thereafter, a

replacement questionnaire, was sent to non-respondents. The demographic characteristics of the respondents are described in Table 1.

2.3 Questionnaire

The questionnaire, entitled: *Addressing future food and health needs of Baby boomers: Planning for the future* was in several parts. Only data from the section of the questionnaire on *Food safety concerns, dietary and physical activity habits, Personal values, body weight (BMI), and Demographics* are analysed and presented here.

2.3.1 *Food safety concerns*

Respondents were asked: *"How important are the following to you?"* then followed a list of items of sources of concern about food and health issues. This was adapted from the list of items used in Worsley and Scott (2000). The response options ranged from *not important* (0) to *extremely important* (4). The confirmatory factor analysis (CFA) showed three concern factors but very high correlations were found between them. Therefore, we used the six items that reflect the food safety concerns with sound psychometric properties as indicated by non-significant chi-square statistics, $\chi 2\ (9) = 28.26$, $p = .00$ with a scaling correction for MLR $p = 1.60$. The other fit indices were all in the desired range: CFI = 0.98, TLI = 0.97, RMSEA = 0.04 (90% CI: 0.03, 0.06), and SRMR = 0.02. The standardised factor loadings of the six items ranged from .54 to .73, indicating that each item reflected the construct well.

2.3.2 *Dietary and physical activity habits*

We wanted to know about how people use different strategies to achieve or maintain a healthy weight. A ten item scale measuring dietary and physical activity habits was adapted from Kruger, Blanck, and Gillespie (2008). This set of items asked "How often do you do

any of the following to achieve or maintain a healthy weight?" For example, item 1: *keep track of the calories you eat during the day*. The list of the dietary and physical activity habit items is presented in Table 2. A five point response scale was given ranging from *never* (1) to *always* (5).

2.3.3 *Personal Values*

Eight items from the Schwartz Values Inventory (Schwartz, 1992), similar to those used in previous studies (Worsley & Skrzypiec, 1998) were listed. Respondents were asked to rate the importance of each of the values in their lives by circling a number in the rating scales ranging from 0 (*not important*) to 4 (*extremely important*). Two dimensions of personal values: *universalism* (5 items, $\alpha = .75$, e.g., *unity with nature*), and *conformity* (3 items, $\alpha = .67$, e.g., *honouring of parents and elders*) from the Schwartz Personal Values inventory (Schwartz, 1992) were used in the present analyses.

2.3.4 *Body Mass Index (BMI*)

BMI was calculated from self-reported height (cm) and weight (kg). Self-reported height and weight have been found to be valid measures for BMI estimation (Venn et al., 2007).

2.3.5 *Demographics*

Demographic information was elicited including details of gender, age, family income, education, and marital status. Women were over represented in the present study (40% of men vs 60% of women). Respondents' mean age was 57.05 years (men: 57.51 years vs women: 56.74 years) with a standard deviation of 7 years (men: 7.01 years vs women: 6.98 years). More men than women were married or live with partner (81.8% of men vs 76.1% of women). Thirty five percent of respondents (men: 34.3% vs women: 35.4%) reported family

income range of $50,000 - $100,000 pa and only 7.8% of them (men: 6.4% vs women: 8.9%) claimed a family income of less than $20,000 pa. While 25.2% of men completed TAFE or college diploma, certificate or formal trade qualification, followed 19.9% of men held postgraduate qualification, 24.5% of women participated some secondary school, followed by 22% completed trade qualification.

2.4 Analytical procedure

Multi-group structural equation modelling (SEM) was employed in the present analyses because (1) SEM extends traditional multivariate statistical analyses (e.g., multiple regression) in at least two important ways: accounting for measurement errors involved in psychometric measures, and providing tests of goodness-of-fit for hypothesised theoretical models to sample data (Bollen, 1989). (2) The food and health literature shows differences in cognition and behaviour between men and women (e.g., Beardsworth, et al., 2002) and the present data showed gender differences in food safety concerns and eating, eating out and physical activity behaviours. Thus, multi-group SEM was carried out to examine the extent to which the measurement and structure models are invariant between gender groups.

The data were analysed using SPSS 17 (SPSS, 2012) and Mplus 6.12 (Muthén & Muthén, 1998-2012). To remedy the non-normally distributed data, the robust maximum likelihood (MLR) estimation method was used. Model evaluations were examined by the MLR chi-square statistics and accompanying significance tests. Goodness-of-fit indices reported here are the standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), Tucker-Lewisindex (TLI), and Comparative fit index (CFI) (Jackson, Gillaspy, & Purc-Stephenson, 2009). When the models were considered to fit the

data well, the following criteria were met: chi-square probability $p > .05$, SRMR < .05, RMSEA < .05, TLI > .95, and CFI > .95.

The independent variables included in these analyses were age, education, household income, marital status, body weight (BMI) and personal values (guiding principles in people's lives). As BMI can be regarded as a fairly stable body condition that is difficult to change in the short term, it was used as a personal background variable along with the personal characteristics. The personal values were universalism and conformity. The intermediary latent variable was the concern factor (food safety concerns, reflected by six items) and the outcome latent variables were eating behaviour, eating out, and physical activity.

Measurement invariance examines whether a common factor model holds across multiple populations with identical pattern structure and parameter values (Vlachopoulos, 2008). Partial measurement invariance exists when some, not all parameters are invariant. CFA provides statistical tests of invariance for all parameters simultaneously, apart from those parameters that must be constrained for identification (Millsap & Kwok, 2004). Models constraining factor loadings to be invariant across groups is the minimum acceptable criterion for group invariance testing (Jöreskog & Sörbom, 1988). Structure invariance tests whether the relationships between the construct variables are equivalent across groups.

A systematic stepwise approach needs to be followed when testing the invariance of a hypothesised model across groups (Hagger, Asçi, & Lindwall, 2004). Firstly, the measurement model must hold for each group separately. Then, a baseline model is estimated simultaneously across the groups to establish whether the factor structure of the model adequately represents the data in all groups (i.e., configural invariance). This baseline model

then serves as a reference model to compare subsequent constrained models. The next step is metric invariance in which the factor loadings of the same items are constrained to be equal across groups.

In testing measurement invariance, identifying the referent indicators is one of the issues for further understanding and improving methods and procedures (Vandenberg, 2002). The selection of the referent indicator needs to be systematically approached and only an item that is truly invariant should be selected as the referent.

The statistical significance of the replicability is usually evaluated through the $\chi 2$ difference test, which is simply the difference between the $\chi 2$ values of the more constrained model and the less constrained model. Its degrees of freedom equal the difference between the two respective values. A non-significant value of the $\chi 2$ difference statistic suggests that the overall fit of the two models is comparable. However, when distributional assumption of estimation methods (e.g., ML estimation) is violated, the MLR scaled $\chi 2$ is the preferred $\chi 2$ test statistic for rescaling normal $\chi 2$. In the present analysis, Muthén and Muthén (2005)'s method was used to compute the desired χ 2 difference test of nested models using MLRχ 2.

3. Results

Table 1 shows the demographic characteristics across gender. The respondents were aged between 38 and 79 years with a mean age of 57.05 years and a standard deviation of 7 years (mean age of 57.51 years for men and 56.74 years for women). Thirty six percent of the respondents had tertiary education, comprising 37.7% of men and 35.8% of women. The majority of the respondents had annual incomes over $50,000 (64.3% of men and 57.9% of women). In addition, the respondents' BMI ranged from 15.05 to 90.00 kg/m^2 with a mean of

26.90 kg/m^2 and a standard deviation of 5.68 kg/m^2 (a mean BMI of 27.42 kg/m^2 for men and 26.55 kg/m^2 for women).

Table 1 here

The concern items were derived from previous studies (Worsley & Lea, 2008; Worsley & Scott, 2000). CFA showed that six items measuring safety and health formed a valid and reliable scale (all the fit statistics were in desirable range with significant factor loadings, Cronbach's alpha = 0.80). Three constructs assessing dietary and physical activity habits were adapted from Kruger, et al. (2008) namely, eating habits, eating out, physical activity with the reliability alpha values of .82, .60, and .60 for each construct, respectively. Table 2 presents the items measuring each construct and its Cronbach's alpha as well as the percentages of the response options on each item across gender and its chi-square statistics. It can be seen that gender differences on half of the concern items and all the eating and eating out habit items were predominant.

Table 2 here

Based on the dimensionality obtained in the personal values literature (Schwartz, 1992), two constructs were used in the present analyses, namely universalism and conformity and the Cronbach's alpha values obtained from the current data were .75 and .67, representing reasonable reliability of the constructs. Two summated scores were formed for universalism and conformity values as independent variables in the SEM models.

Prior to simultaneously testing the models in a single analysis, the measurement models (factors of concerns, and dietary and physical activity habits) and the structure model were tested for the whole sample (n = 1095) as well as the separated samples of gender groups (n = 438 for men, n = 657 for women) to examine the convergent and discriminant validities of the measurement models, to identify the referent items of the measurement models, and to assess whether the hypothesised conceptual model fits the samples well. Table 3 presents the model fit statistics for the measurement models and the structure model across the whole, male, and female samples. The fit statistics suggest that the models fit the data reasonably well (e.g., CFI: .89-.98, SRMR: .02-.05).

Table 4 shows the results of invariance testing (configural and metric) for the measurement models and the structure model. Firstly, the factor loadings of the concern measurements were freely estimated across the gender groups except the identified referent item (fixed for model identification purpose) of "*the safety of take away foods*". Secondly, all the factor loadings were constrained to be equal across the gender groups. The p value of .20 for the adjusted χ^2 difference suggested that the metric invariance was supported. That is that all the factor loadings for male and female samples can be assumed to be equal across the groups.

The configural and metric invariance of the measurement model concerning dietary and physical activity habits with three constructs were also examined (Table 4). In this measurement model, the items: "*Try to keep fewer high fat, high calorie foods at home*", "*Often share your dessert with someone else*", and "*Do flexibility exercises several times a week*" were identified as referent items. When the p value of .02 for the adjusted chi-square difference suggested that the metric invariance across the gender groups was not supported, item "*In restaurants or take ways, often order a reduced sized entrée*" was unconstrained and

the metric invariance was tested again with the rest of the items constrained across groups. The results showed that the partial invariance was supported with a *p* value of .12 for the adjusted chi-square difference.

Finally, the structure invariance was tested (Table 4). All the factor loadings of the measurement models were constrained excepted for the non-invariant item "*In restaurants or take ways, often order a reduced sized entrée*". Some of the non-invariant regression coefficients were also unconstrained in the metric invariance of the structure model. The unconstrained coefficients included the associations between (1) the food safety and health concern factor and eating out habits, (2) age and the concern factor, (3) BMI and the concern factor, (4) income and the concern factor, (5) age and physical activity, and (6) BMI and physical activity. A non-significant *p* value of .95 for the adjusted chi-square difference suggested that the partially constrained SEM model was supported across the gender groups (see Figure 1).

Figure 1 here

Figure 1 illustrates the SEM model with the unstandardized and standardized parameter estimates for both genders. Among all the regression coefficients between the independent variables (demographics, BMI, and personal values), dependent variable (food safety concerns), and the outcome variables (eating, eating out, and physical activity habits), nine significant associations were invariant across the gender groups. These nine significant associations included the negative relationship between education level and the concern factor; and positive relationships between the following variables: universalism and the concern factor; conformity and the concern factor; marital status and eating out habits;

income and eating habits; universalism and eating habits; universalism and eating out habits; universalism and physical activity; and the concern factor and eating habits. Moreover, universalism had significant indirect effect of .06 with 95% confidence interval between .02 and .11 on eating behaviour via food safety concern for men and women.

Interestingly, some associations varied between men and women. For example, age was positively related to the concern factor but negatively linked to physical activity among women but not men. Food safety concerns were positively related to BMI but negatively associated with income among men but not women. Moreover, physical activity was negatively related to BMI among women but not men. Furthermore, eating out habits were positively linked to the concern factor among women but not men. Finally differences in significant indirect effects were found between male and female models. For men, income had a significantly indirect effect of -.02 with a 95% confidence interval ranged from -.03 to -.00 on eating behaviour via concern. Among women, the indirect effect from universalism to eating out behaviour via food safety concerns was .07 with a 95% confidence interval between .02 and .11.

The male interrelationships (Figure 1a) appear to be slightly different to the female relationships (Figure 1b). For each gender, complex patterns of relationships existed between the demographics, body weight and values antecedents with the three dietary and physical activity habit constructs. Food safety concerns appeared to play a central role between the stable predisposing variables such as demographics, BMI, and values.

In summary, women and men's eating, eating out, and physical activity habits appear directly or indirectly related to social economic position, body weight, as well as values influences

through concerns about food and health, although the relationships varied between male and female samples

4. Discussion

4.1 Equivalent relationships across gender groups

Men and women with lower levels of education were more likely to have higher levels of food safety and health concern. Education level partly indexes individuals' SES. The findings are supported by earlier studies that less educated men and women were more concerned about most food and health related issues (Worsley & Lea, 2008; Worsley & Scott, 2000). Because people of lower SES may lack social and health support and resources, and experience greater powerlessness; this may lead to greater concern about food and health issues.

Universalist and conformity values were positively related to food safety concerns for both genders. Men and women who held strong universalism and conformity values, were more likely to practice healthy eating, eating out, and physical activity behaviours. The findings are consistent with previous studies which have demonstrated positive relationships between universalism and food attitudes and healthy eating behaviours (Brunsø, Scholderer, & Grunert, 2004; Worsley & Lea, 2008; Worsley & Scott, 2000). Similarly to this study, Wang, Worsley, and Hunter (2009) found that universalism positively impacted on healthy eating, eating out, and physical activity through cognitions. These particular findings suggest that the more people are concerned about food and health issues, the more they are aware of and capable of healthy eating behaviours.

Finally, men and women with higher incomes were more likely to practice healthy eating behaviours. This is consistent with previous findings that people with lower incomes are

likely to have lower self-esteem and confidence, practice more unhealthy behaviours, and experience more health problems (Edwards, 2011; Marmot, 2005; Wilkinson, 1997).

The overall novel contribution of these findings lies in the identification of two major influences on the dietary and physical activity habits of this middle-aged population sample; both demographics and universalist values had direct effects on them. The influence of demographics has been shown in previous studies but the influence of universalism, a set of communitarian, other directed values, is relatively novel.

Second, the centrality of food safety concerns as a mediator between demographic and conformity variables, and, dietary and physical activity habits, illustrates the interdependence between seemingly distinct aspects of human experience. Certain demographic and values factors influence anxieties about food issues, which in turn, influence aspects of dietary and physical activity practices. It remains for further research to examine how far these concerns extend to other health and life concerns, values, social circumstances and daily behaviours. At present, the findings suggest that food safety concerns may be effective mediators of dietary and physical activity habits which may have policy and communication implications (4.4 below).

4.2 Gender differences

Men of lower SES (indexed here by family income) had greater food safety concerns. This is consistent with our previous studies which showed that people on lower incomes are more critical of government over health regulatory matters (Blasche, Worsley, & Lawrence, 2008) and of school food provision (Worsley, 2007) perhaps because they are more exposed to these issues than richer, better connected people. The lack of a similar finding in lower

income women may be due to their greater involvement in, and control over, food matters (Esterik, 1999).

The finding that concerns, and physical activity were positively associated with age among women only is supported by previous studies (Beardsworth, et al., 2002; Worsley, 1988; Worsley & Scott, 2000; Worsley & Skrzypiec, 1997, 1998). The general explanation put forward in these studies is that women are more involved in and responsible for food matters when compared to men (Stanton, 2009). The positive relationship between physical activity and age among women may be because older women have more time for physical activity than those who are in the workforce.

The negative relationship between women's body weight (BMI) and physical activity, is consistent with earlier findings that people who were overweight (BMI $\geq$ 25 kg/m^2) were more likely to be physically inactive, and women were less likely than men to participate in moderate to high levels of physical activity (Salmon, Bauman, Crawford, Timperio, and Owen (2000)).

The positive relationships between BMI and concerns among men but not women might be explained by the fact that women's health conditions (e.g., heart disease) are generally under diagnosed (Mikhail, 2005) and undertreated (Jneid & Thacker, 2001). This, together with metabolic disease screening and associated physician advice may make overweight and obese men more aware of their health and thus greater concerns about food. An alternative explanation, that obese people experience greater stigma and thus more become aware of food issues does not seem plausible given the greater experience of stigmatisation among women (Puhl & Heuer, 2009).

Finally the positive relationship among women between concerns and dining out is in agreement with previous studies which have shown that women tend to favour "healthier" meals (Rappoport, Peters, Downey, McCann, & Huff-Corzine, 1993), follow healthy eating recommendations, are more likely to be engaged in attempts to lose weight (Beardsworth, et al., 2002).

4.3 Limitations and future directions

The present study examined the food concerns and behaviours of people aged 38 to 79 years. The broader population, including people aged less than 38 years, were not represented in this study. A wider range of food concerns scales still need to be developed to include validated scales which assess environmental, nutritional and human welfare concerns among others. The findings strongly suggest that longitudinal studies of food concerns are required in order to better assess their causation as well as to confirm the position of the health background variables including BMI, as predictors in the present structural model. In addition, women were over represented in the current study (60% women versus 40% men), which may introduce bias. Therefore, the findings should be treated with caution.

4.4 Implications

The findings have implications for food policy and health promotion. They suggest that a focus on people' personal values and food concerns is likely to engage them to alter their dietary and physical activity habits. Those with strong universalism and conformity values are more likely to be interested in food and health issues and they may be more responsive to health communications to improve their healthy eating and eating out behaviours. More broadly, the findings suggest that communications may need to be framed in different ways

for men and women (Van Assema, Martens, Ruiter, & Brug, 2001). For example, food safety concerns were related to healthy eating out for women but not for men. Therefore, communications for women should refer to these concerns. Similarly, the different impacts of body weight on food safety concerns and physical activity between the genders suggest that communications needs to deal with body weight in different ways for men and women. Finally, the links between these habits and universalism, suggest that communications about them might be framed within a social, outwardly oriented context, perhaps on group as well as individual goals

The broad implication of these findings for food policy makers is that a focus on food safety concerns, and other relatively malleable variables like personal values, is likely to bring about changes in dietary and physical activity habits of gender groups. In the longer term this may contribute to changing structural inequities associated with high body mass, social class, gender and age.

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Table 1. Socio-demographic characteristics across gender groups

Demographics		Male (n = 438)	Female (n = 657)	Total (n = 1095)
Age	Range (yrs)	41-79	38-76	38-79
	Mean (yrs)	57.51	56.74	57.05
	(SD)	(7.01)	(6.98)	(7.00)
Education (%)	Primary school or less	1.1	.9	1.0
	Some secondary school	17.8	24.5	21.9
	Completed secondary school or on-job training	18.1	16.8	17.3
	TAFE or college diploma, certificate or formal trade qualification	25.2	22.0	23.2
	Graduate tertiary qualification	17.8	18.9	18.5
	Postgraduate tertiary qualification	19.9	16.9	18.1
Household Income (%)	$10k or less	1.2	2.0	1.6
	$10-20k	5.2	6.9	6.2
	$20-35k	12.9	15.5	14.4
	$35-50k	16.4	17.8	17.2
	$50-100k	34.3	35.4	34.9
	$100k or more	30.0	22.5	25.6
Marital status (%)	Not married/widowed	18.2	23.9	21.6
	Married/live with partner	81.8	76.1	78.4
BMI	Range (kg/m^2)	15.05-90	16.23-64.32	15.05-90.00
	Mean (kg/m^2)	27.42	26.55	26.90
	(SD)	(5.63)	(5.69)	(5.68)

Note: SD = standard deviation

Table 2. Percentage of importance of food safety concerns and frequencies of activities across gender groups

Safety concerns (α = .80)	% important		χ^2 (*df* = 1)
	Male (*n* = 438)	Female (*n* = 657)	
1. harmful bacteria in food	69.5	77.0	7.78**
2. enforcement of food regulations	85.8	89.0	2.43
3. uncertainty about what is in foods	72.9	82.8	15.20**
4. the safety of take away foods	71.3	76.3	3.44
5. high salt content of many processed foods	76.5	88.8	29.04**
6. clean handling of food in shops	93.0	95.2	2.36
Dietary and physical activity habits	% sometimes-always		
Eating habits (α = .82)			
1. Keep track of the calories you eat during the day	15.7	34.2	45.05**
2. Try to eat smaller amounts of food at meals	51.4	70.0	40.76**
3. Try to balance the food you eat with the amount of physical activity you do	55.4	69.4	22.06**
4. Try to keep fewer high fat, high calorie foods at home	69.7	84.4	33.28**
5. Try to snack on fruits and vegetables instead of high-fat, high-calorie snacks	74.4	87.6	31.37**
Eating out habits (α = .60)			
6. Limit your dining out to two times per week or less	80.6	85.2	3.93*
7. In restaurants or take ways, often order a reduced sized entree	41.3	68.0	74.16**
8. Often share your dessert with someone else	51.4	68.1	29.79**
Physical activity (α = .60)			
9. Do at least 30 minutes activity each day	82.1	82.9	.13
10. Do flexibility exercises several times a week	50.2	52.5	.55

Note: *$p < .05$, **$p < .01$.

Table 3

The χ^2 statistics and fit indices for the measurement and structure models

Sample	Model	*MLR* χ^2	*Scaling correction factor for MLR*	*df*	*p*	*RMSEA*[a]	*NNF*
Food safety concerns							
Whole sample (*n* = 1095)	Measurement	28.26	1.60	9	.00	.04 (.03, .06)	.97
Male (*n* = 438)	Measurement	15.72	1.40	9	.07	.04 (.00-.08)	.97
Female (*n* = 657)	Measurement	22.51	1.69	9	.01	.05 (.02-.07)	.96
Health behaviours							
Whole sample (*n* = 1095)	Measurement	123.08	1.12	24	.00	.06 (.05, .07)	.92
Male (*n* = 438)	Measurement	74.83	1.06	24	.00	.07 (.05, .09)	.89
Female (*n* = 657)	Measurement	83.49	1.14	24	.00	.06 (.05, .08)	.92
Whole sample (n = 1095)	Structure	484.22	1.08	175	.00	.04 (.04, .05)	.89
Male (*n* = 438)	Structure	315.86	1.04	175	.00	.05 (.04, .05)	.87
Female (*n* = 657)	Structure	336.05	1.09	175	.00	.04 (.03, .05)	.91

[a] 90 % Confidence Interval for RMSEA is presented in brackets.

Table 4
Summary of tests for measurements across gender groups

	CFI	TLI	SRMR	RMSEA	MLR χ^2	*df*	Scaling correction factor	Δ*df*	cd	T
Measurement invariance of food safety concern										
model A (Configural)	.96	.95	.04	.06 (.04-.07)	59.22	22	1.52	6	1.15	8
model B (Matric)	.96	.96	.07	.05 (.04-.07)	69.31	28	1.44			
Measurement invariance of dietary and physical activity habits (3 factors) across gender groups										
model C (Configural)	.93	.90	.05	.07 (.06-.08)	186.15	54	1.09	6	1.09	1
model D (Matric)	.92	.91	.05	.07 (.06-.08)	200.74	60	1.09			
model E (Partial matric: free q23G)	.93	.91	.05	.07 (.06-.08)	194.84	59	1.09	5	1.09	8

Structure invariance										
model A (Configural)	.90	.89	.05	.04 (.04-.05)	710.76	371	1.07	11	1.07	4
model B (Partial matric)	.90	.89	.05	.04 (.04-.05)	715.43	382	1.07			

Note: CFI=Comparative Fit Index; TLI=Tucker-lewis Index; SRMR=standardized root-mean-square residual; RMSEA=root-mean-square error of approximation; MLR χ^2 =Robust Maximum Likely Chi-square; *df*=degree of freedom; Δ*df*=difference in degree of freedom;
cd=difference in test scaling correction; TRd=adjusted χ^2 difference.
Item q23G -*In restaurants or take away, often order a reduced sized entrée*

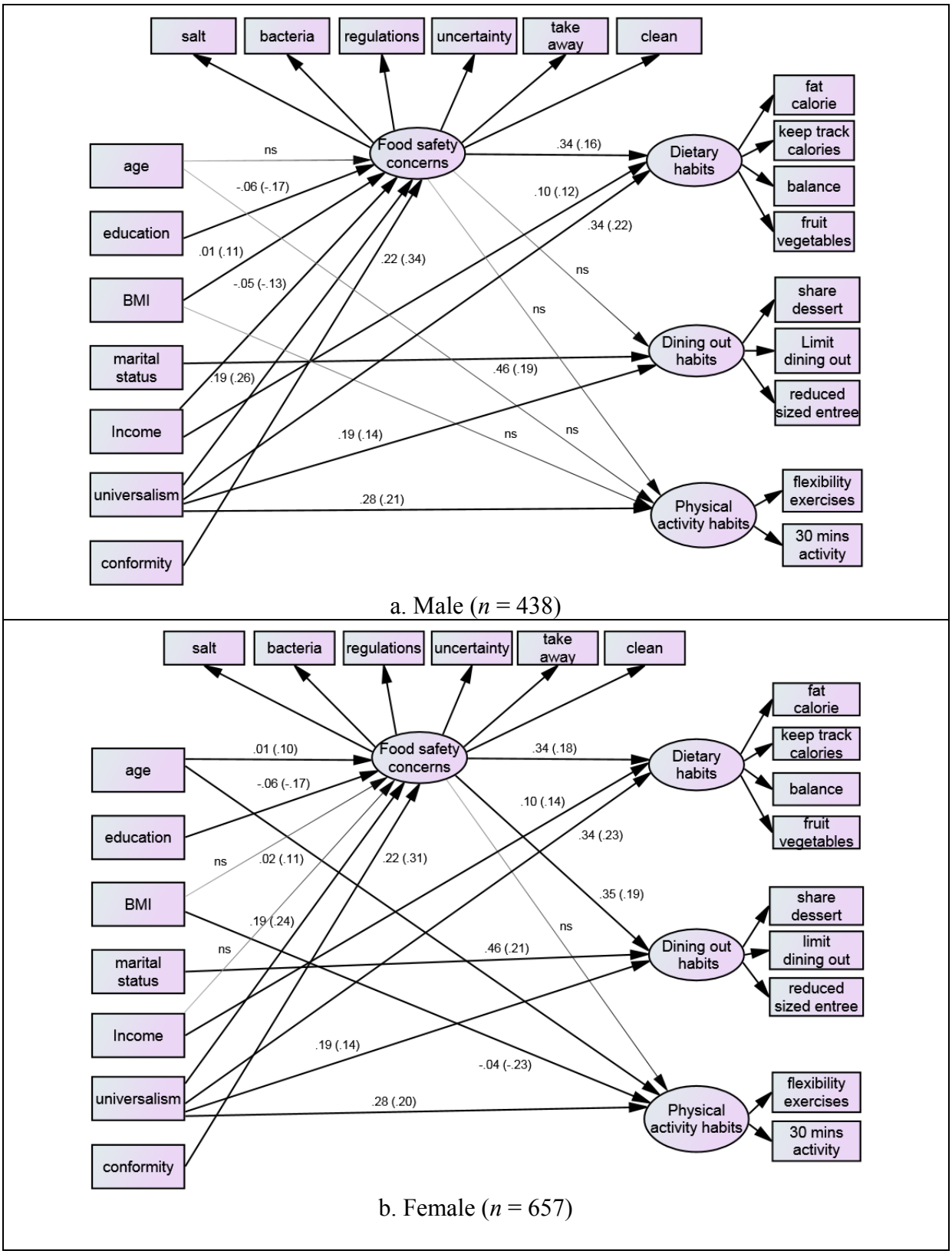

Figure 1. Unstandardized (standardized) parameter estimates for male and female participants