

# Consumption of Pork by Australians - A Secondary Analysis of the 2011- 2013 Australian Health Survey

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Report prepared for the  
Co-operative Research Centre for High Integrity Australian Pork

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**Business**  
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## **Executive Summary**

### ***Rationale for undertaking the Project***

There is a lack of current research exploring the consumption of pork and its associated nutritional benefits for Australian adults. The rapidly changing nature of the food supply and consumer preferences requires the analysis of more recent and nationally representative dietary surveys to gain a clear understanding of current pork consumption and related health outcomes in the Australian diet. The 2011-2013 Australian Health Survey is the first representative nutrition survey to be conducted in Australia since 1995. Nutrition data from this survey provides the most up-to-date data available on the dietary intakes and eating habits of Australians. Outcomes from the analysis of this survey provide both insights valuable for the strategic marketing of pork products and further evidence relating to the important nutrition contribution of pork to the diet of Australians.

### ***Outcomes of the project***

This study identified that just over a third (37.4%) of Australians reported eating pork on the survey day evaluated, with the vast majority consuming processed pork rather than fresh pork. Ham was the pork product consumed in the greatest quantity, followed by bacon. Pork loin was the fresh pork variety consumed in the greatest quantity.

Males consumed pork in greater quantities than females overall, with a higher proportion of people consuming fresh pork born in non-English speaking countries than Australia or another major English speaking country. A greater number of fresh pork consumers lived in a major Australian city in comparison to a regional or other area.

The consumption of pork was beneficial to the nutrient intake of consumers, with more pork consumers meeting their dietary requirements for protein, long chain omega-3 polyunsaturated fatty acids, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, phosphorous, zinc, iron, iodine and selenium than non-consumers. Pork consumers had significantly higher intakes of protein, fibre, thiamin, monounsaturated fat, iodine and selenium than non-consumers. However it should be noted that intakes of energy, total and saturated fat, cholesterol and sodium were also higher amongst pork consumers.

### ***Relevance of the project's outcomes to the Australian Pig Industry***

This research will contribute to the evidence base surrounding the important position of pork as a core food in the diet of Australian adults and children. The quantification of intakes of processed, fresh and more recently consumed pork varieties (such as pork belly) in addition to demographic analyses of consumers and non-consumers may provide important insights for the strategic marketing of pork varieties to the Australian population. This analysis of the contribution of pork to key nutrient requirements will also be invaluable in terms of providing evidence to substantiate marketing efforts seeking to expose the unique nutritional benefits of consuming pork as part of a balanced diet.

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# 1. Introduction

Pork represents a core food in the Australian diet, as well as in many other cuisine contexts worldwide and is responsible for the contribution of a range of essential nutrients. In a recent analysis of pork consumption in Australian children, fresh pork was found to contribute 13% of total protein consumed, 15% of thiamin, 12.4% of long chain omega-3 polyunsaturated fatty acids, and 10% of niacin, as well as smaller amounts of other essential nutrients such zinc, phosphorous and potassium amongst fresh pork consumers (Nolan-Clark, Neale et al. 2013). In analyses of intakes of pork in the United States of America, fresh pork was found to contribute 27% of dietary protein, 8% of dietary iron, 21% of dietary zinc and 31% of dietary thiamin amongst adults reporting its consumption (Murphy, Spungen et al. 2011).

Data from the 1995 National Nutrition Survey suggest that Australians consumed an average of 6 grams (females) and 11 grams (males) of fresh pork/day (Baghurst, Record et al. 2000). However the rapidly changing nature of the food supply and consumer preferences requires the analysis of more recent nationally representative dietary data to gain a clear understanding of current pork consumption and associated health indicators in Australian adults.

It is particularly important to evaluate intakes of processed pork, to assess compliance with the recently updated Australian Dietary Guidelines that recommend that processed meat intakes be limited (Department of Health and Ageing and National Health and Medical Research Council 2013). The recently completed analysis of the 2007 Australian Children's Nutrition and Physical Activity Survey found that processed pork was consumed in far greater amounts than fresh pork (Nolan-Clark, Neale et al. 2013). Given that a large proportion of processed pork in Australia is imported, it is important to the Australian Pork Industry that the types of pork consumed by adults are investigated, to determine if this pattern is consistent across age categories and to guide the development of marketing campaigns to address this issue.

Obesity is a public health priority in Australia, with representative data suggesting that 63.4% of Australian adults are either overweight or obese (Australian Bureau of Statistics 2014). There is some evidence that pork may be beneficial in the maintenance of a healthy weight range. Consumption of up to 1 kg of lean pork per week resulted in significant reductions in weight, body mass index (BMI), and measures of body fat compared with habitual diet in overweight adults (Murphy, Thomson et al. 2012). In addition, participants eating a diet rich in pork protein for 4 days had a larger increase in 24-hour energy expenditure of compared with diets rich in carbohydrate or soy protein (Mikkelsen, Toubro et al. 2000). Finally, an acute study found that pork increased the secretion of the satiety related gut hormone peptide YY to a greater extent than either beef or chicken (Charlton, Tapsell et al. 2011). Given the severity of the obesity issue in Australia and the known nutritional contributions of pork to the diet, it is important that the positioning of this core food in the Australian diet be evaluated.

The 2011-2013 Australian Health Survey is the first representative nutrition survey to be conducted in Australia since 1995. Nutrition data from this survey provides the most up-to-date data available on the dietary intakes and eating habits of Australians.

The aim of this study was to explore the nutrition and health benefits of pork consumption in the diets of Australians based on the latest available data from the 2011-2013 Australian Health Survey. It is anticipated that outcomes from this

analysis will facilitate the development of innovative strategies to increase pork consumption within the diets of Australians.

To achieve this aim the objectives were as follows:

- Describe the current intake of fresh pork and pork-containing products by Australian adults and children, including a quantitative analysis of the types of pork products consumed and the prevalence of pork consumption amongst Australians
- Identify target groups for the promotion of fresh pork through an analysis of demographic information relating to both high and low pork consumers.
- Compare the nutritional status of pork consumers to non-pork consumers, using current nutrient reference values (NRVs), with a particular focus on the contribution of fresh and processed pork to key nutrients including protein, iron, thiamin and zinc.
- Explore associations between pork intake and several health characteristics of pork consumers

## 2. Methodology

This study involved a secondary analysis of data from the 2011-2013 Australian Health Survey. The 2011-13 Australian Health Survey (AHS) is the largest and most comprehensive health survey ever conducted in Australia and contains a National Nutrition and Physical Activity Survey (NNPAS) component with detailed food consumption data from 12,153 individuals aged 2 years and older. Dietary data was collected via a 24 hour dietary recall and followed-up via a second dietary recall conducted over the telephone (Australian Bureau of Statistics 2013). Dietary recall data were obtained using an Automated Multiple-pass method that was adapted to the Australian food supply. Dietary data was converted into nutrient intake using a specially developed nutrient database, AUSNUT2011-2013, which was developed by Food Standards Australia and New Zealand (FSANZ) (Food Standards Australia and New Zealand). Demographic information, household information and physical measures including body mass index, waist circumference and blood pressure were also collected for all participants in the NNPAS.

Whilst two days of dietary intake data was available for some participants, a substantial proportion (36.4%, n=4418) did not complete multiple dietary recalls (Australian Bureau of Statistics 2013), making it difficult to accurately assess the average intake over the two study days. As pork has been identified as a food that may not be consumed everyday by the majority of the population in other National surveys (Baghurst, Record et al. 2000; Nolan-Clark, Neale et al. 2013) it was not considered prudent to estimate the average pork intake over two days using either the National Cancer Institute (Tooze, Midthune et al. 2006) or the Multiple Source Method (Haubrock, Nöthlings et al. 2011). This is particularly pertinent given the lack of a food frequency questionnaire available with the NNPAS to facilitate estimations of pork consumption frequency. For this reason, all analyses conducted were limited to those obtained during day one of the dietary recall. This method has been adopted in other analyses of pork intake in a nationally representative survey conducted in the United States (Murphy, Spungen et al. 2011).

### ***Classification of pork products in the 2011-2013 Australian Health Survey***

Pork and pork containing dishes were identified from the NNPAS survey dataset using allocated Food Standards Australia and New Zealand (FSANZ) codes. Pork products were classified as 'fresh pork', 'processed pork', and 'mixed dishes containing fresh or processed pork'. Where possible, mixed dishes containing pork

were classified as containing either fresh or processed pork, or additional products which may contain pork were identified to identify other pork products. Survey participants were then classified as either pork consumers or non-consumers, with further differentiations made regarding consumers of fresh and processed pork.

For mixed dishes containing pork, or meat products which contained pork, the percentage pork was calculated using the AUSNUT 2011-13 NNPAS Food Recipe File (Food Standards Australia and New Zealand 2014). Where FSANZ recipes were not available for mixed dishes, professional judgement was used to select the closest FSANZ recipe match. As recipes were not available for a number of food products containing processed pork such as spam and devon, these were assumed to be 100% pork. This practice has been published previously (Nolan-Clark, Neale et al. 2013). Products that were identified to contain less than 5% pork according to the recipe file were excluded from further analysis due to their minimal contribution to pork intakes. This method has been utilized in another secondary analysis of a nationally representative survey (Murphy, Spungen et al. 2011) to avoid incorrect measurement of pork intake. Survey participants were then classified as pork consumers or non-consumers. Further differentiations were made regarding consumption of fresh and processed pork.

The proportion of individuals consuming pork of any kind was identified, as well as the proportion consuming fresh and/or processed pork.

All pork eaten was categorized into one of the following major categories for quantification:

- Bacon
- Chorizo
- Devon
- Frankfurt
- Ham
- Kabana/cabanossi
- Other processed meat containing pork (includes Berliner, Brawn, Black pudding, Polish sausage, Liverwurst, Mortadella, Spam and Strasburg)
- Other pork containing dishes (includes pickled pork, pork crackling, pork not further specified, pork rind and pork head)
- Pork butterfly
- Pork diced
- Pork fillet
- Pork forequarter
- Pork leg
- Pork loin
- Pork mince
- Pork scotch roast
- Pork spare ribs
- Pork strips
- Prosciutto
- Salami
- Sausage
- Pork rump steak
- Pork belly

The mean + standard deviation, median and interquartile range of consumption of total pork and categories of pork was calculated for both the total population, and for those consuming some type of pork. Pork consumption by gender and age group was also determined for the total population and pork consumers only.

### ***Analysis of the demographic characteristics of pork consumers versus non-consumers***

The frequency and proportion of a range of demographic characteristics for pork consumers and non-consumers were calculated including gender, age range (classified for consistency with Australian Nutrient Reference Values (National Health and Medical Research Council 2006), country of birth, remoteness, index of relative socio-economic disadvantage (SEIFA) quintiles and household income range (equivalised based on the number of members of the household, Appendix 1). Participants were not categorized according to level of education or marital status as the sample included both children aged over 2 years in addition to adults, limiting the usefulness of the data.

Chi-square analyses were conducted to assess whether significant differences in the proportions of responses relating to demographic characteristics between pork consumers and non-consumers were present. Where significant differences were identified, post-hoc chi-square analyses with Bonferroni adjustment were conducted to identify the source of the variation. In addition to this, the above analyses were also completed for consumers of fresh and processed pork. As the purpose of this specific analysis was to investigate the demographic characteristics of fresh and processed pork consumers, rather than all survey participants as a whole, this analysis was restricted to only those individuals who consumed some type of pork, and were subsequently categorized as fresh and/or processed pork consumers and non-consumers.

### ***Analysis of the contribution of pork to nutrient intakes***

The mean  $\pm$  standard deviation, median and interquartile range of intake of nutrients including energy (kJ), protein (g), total fat (g), sugar (g), carbohydrates (CHO) (g), fibre (g), iron (mg), thiamin (mg), saturated fatty acids (g), monounsaturated fatty acids (MUFA) (g), polyunsaturated fatty acids (PUFA) (g), cholesterol (mg), long chain omega 3 fatty acids (LC n-3 PUFA) (mg), riboflavin (mg), niacin (mg), vitamin B6 (units), vitamin B12 (units), phosphorous (mg), magnesium (mg), zinc (mg), potassium (mg), iodine (ug), selenium (mg) and sodium (mg) was calculated for both pork consumers and non-consumers. Nutrient intake data was quantified without taking into consideration dietary supplement data as this project aimed to determine the contribution of pork to the dietary intake of Australians during the day of the survey. Nutrient intakes were adjusted for total energy using the residuals method outlined by (Willett 1998). Energy adjusted nutrient intakes were then compared between pork consumers and non-consumers using independent t-tests, following log transformation of non-parametric variables.

The contribution of pork to intakes of a range of nutrients was then calculated as a proportion of total nutrient intakes. Nutrient intakes from pork were also compared to nutrient reference values for key nutrients. Where available, nutrient intakes from pork were compared to the Estimate Average Requirements (EAR), which is the most appropriate method of assessing the adequacy of nutrient intakes in groups (National Health and Medical Research Council 2006).

Where an EAR did not exist, the Adequate Intake (AI) of the nutrient, was used as a reference value. Comparison to EAR and AI values was limited to nutrients with a single EAR or AI value for each gender and age category (rather than an EAR or AI range for a single category). For each survey participant, the appropriate EAR or AI was selected for comparison based on their age and gender.

In order to determine the nutrient contribution of pork alone, FSANZ retention factors (Food Standards Australia and New Zealand 2014) were applied to pork present in recipe items, to approximate nutrient losses during cooking, and

moisture gains or losses with cooking (as specified in the FSANZ AUSNUT 2011-13 food recipe file (Food Standards Australia and New Zealand 2014) were taken into account. Mixed dishes which did not have a corresponding FSANZ recipe were required to be excluded from the calculations of the nutrient proportions provided by pork, as the absence of retention factor data meant nutrient losses during cooking could not be determined. A list of excluded recipe items is presented in Appendix 2. Outliers with implausible proportions of pork nutrient contributions were also excluded from the analysis. Finally, the frequency and proportion of survey participants meeting the EAR or AI for key nutrients was calculated. Chi-square analyses were conducted to assess whether significant differences in the proportions of individuals meeting nutrient requirements existed between pork consumers and non-consumers.

In addition to this, the nutrient analyses listed above were also completed for consumers of fresh and processed pork. As the purpose of this specific analysis was to compare nutrient intakes of fresh and processed pork to those who did not consume pork, the entire survey sample was used in this analysis.

### ***Health indicators associated with pork consumption***

Chi-square analyses were conducted to assess whether significant differences in both blood pressure categories and BMI categories between pork consumers and non-consumers were present. Where significant differences were identified, post-hoc chi-square analyses with Bonferroni adjustment were conducted to identify the source of the variation. These analyses were repeated for both fresh and processed pork consumers.

For the purpose of these analyses, blood pressure was categorized into the following groups:

- Normal (blood pressure  $\leq 120\text{mmHg}/80\text{mmHg}$ )
- Normal to high (blood pressure  $> 120\text{mmHg}/80\text{mmHg}$  to  $< 140\text{mmHg}/90\text{mmHg}$ )
- High (blood pressure  $\geq 140\text{mmHg}/90\text{mmHg}$ )

It should be noted that the Australian Health Survey only collected this data for individuals over 18 years, thus results discussed are limited to the adult population.

Similarly, for the purpose of these analyses, BMI was categorized into the following groups according to accepted cut offs for both adults and children:

- Underweight
- Normal weight
- Overweight
- Obese

To determine whether there was any association between pork consumption and both body weight and waist circumference, independent samples t tests were performed to compare means between the following groups:

- pork consumers and non-consumers
- processed pork consumers and non-consumers (that reported consuming any pork)
- fresh pork consumers and non-consumers (that reported consuming any pork)

Independent samples t tests were selected in preference to one-way between-group analyses of covariance (ANCOVA) analyses as the data set violated several of the assumptions required to utilize this statistical method effectively including the assumptions of homogeneity of regression slopes and variances. It was thus not

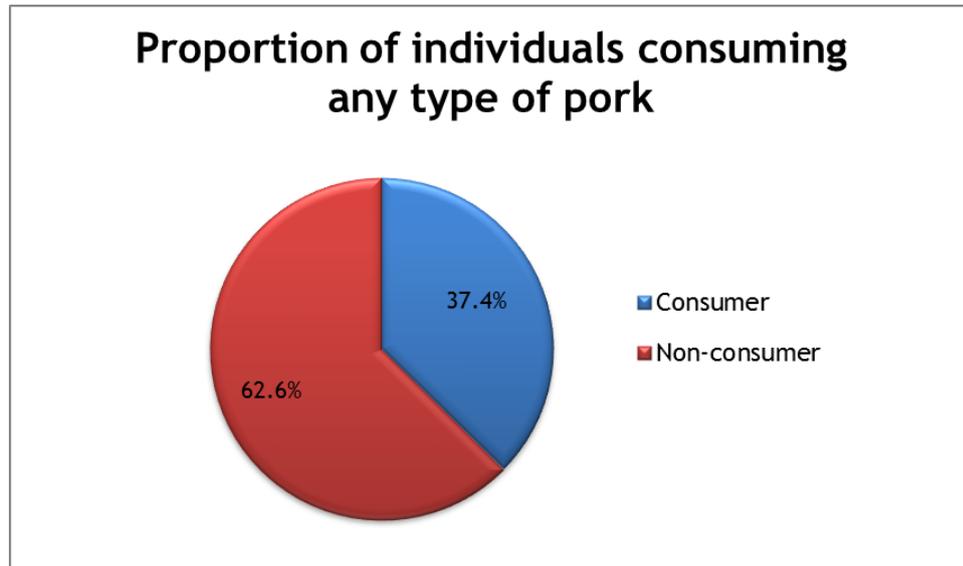
possible to control for several potential confounding factors that may influence body weight and waist circumference such as physical activity levels and total kilojoule intake. Thus, results discussed should be viewed with this limitation in mind.

### ***Statistical Analyses***

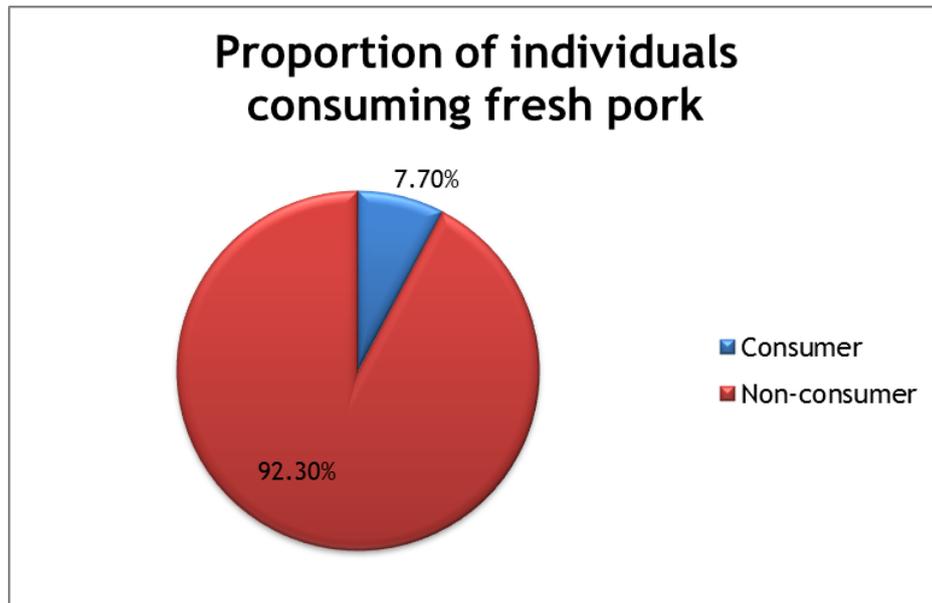
Following an initial collation of the data set using Microsoft Excel (Microsoft Corporation, 2010, Version 14.0.7), all statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 22 (SPSS Inc., Chicago II, USA). All dietary intake data was weighted according to the person weights provided by the Australian Bureau of Statistics (Australian Bureau of Statistics 2013) to address the potential of sampling errors and seasonal variation in the survey data. Significant differences were identified at  $\alpha < .05$ .

### **3. Outcomes**

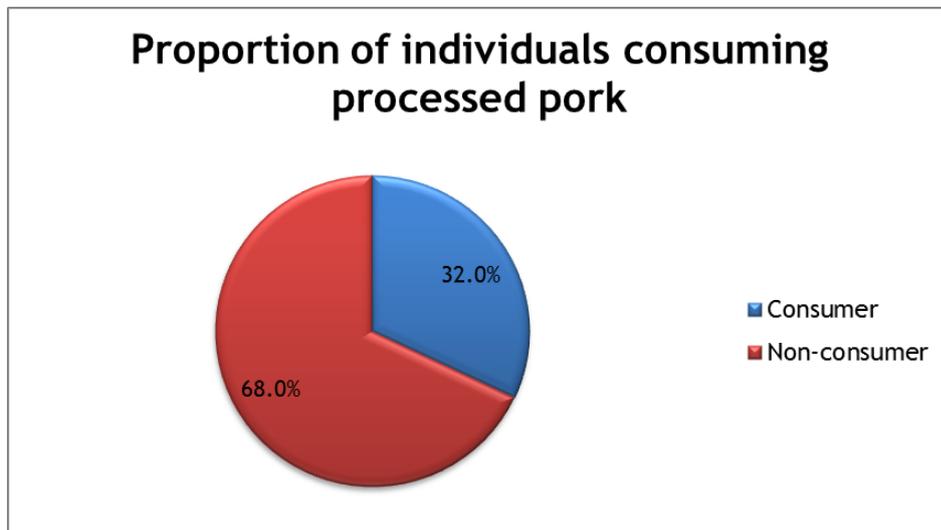
On the day of the survey examined, 37.41% (n=4501) of the study population reported consuming pork, whilst 62.58% (n=7652) reported that they did not consume pork (Figure 1). Additional analyses of the proportion of individuals consuming either fresh or processed pork on the day of the survey are presented as Figure 2 and Figure 3.



**Figure 1 - Proportion of pork consumers and non-consumers in the 2011-2013 Australian National Nutrition and Physical Activity Survey (n=12153).**



**Figure 2 - Proportion of fresh pork consumers and non-consumers in the 2011-2013 Australian National Nutrition and Physical Activity Survey (n=12153).**



**Figure 3 - Proportion of processed pork consumers and non-consumers in the 2011-2013 Australian National Nutrition and Physical Activity Survey (n=12153).**

Within the sample reporting consumption of pork on the day of the survey (n=4501), 20.57% of pork consumers reported consuming fresh pork; whilst 85.52% reported consuming processed pork (percentages do not equal 100% as some individuals reported intakes of both fresh and processed pork).

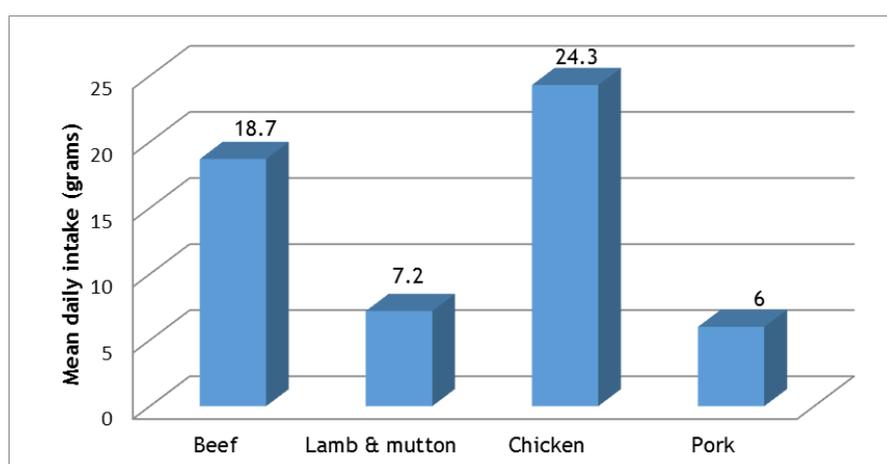
Data was further classified to determine mean intakes of all pork (including processed and fresh), all fresh pork (including fresh pork contributed from mixed dishes), all processed pork (including processed pork contributed from mixed dishes) and mixed dishes containing either processed or fresh pork for both the total sample (n=12153) and the sample reporting pork consumption (n=4501). Results for this analysis are displayed in Table 1.

**Table 1 - Mean intakes of pork (grams) consumed by Australians on day one of the 2011-2013 Australian National Nutrition and Physical Activity Survey by category of pork**

Pork Category	Total sample (n= 12153)			Pork consumers (n=4501)		
	Mean±SD*	Median	IQR**	Mean±SD*	Median	IQR**
All pork	22.01 ± 48.53	0.00	0.00 - 22.74	58.82 ± 64.26	35.93	17.00 - 73.25
All fresh pork	7.68 ± 36.11	0.00	0.00 - 0.00	20.53 ± 56.76	0.00	0.00 - 0.00
All processed pork	9.75 ± 28.54	0.00	0.00 - 00.0	38.30 ± 43.81	24.00	15.24 - 50.0
Mixed dishes containing fresh pork	1.74 ± 13.13	0.00	0.00 - 0.00	4.65 ± 21.15	0.00	0.00-0.00
Mixed dishes containing processed pork	4.58 ± 16.05	0.00	0.00-0.00	12.23 ± 24.39	0.00	0.00-0.00

\*SD=standard deviation \*\*Interquartile range

To put this intake information in context, generalized data on the mean daily intake of unprocessed beef, lamb/mutton and chicken was obtained from the Australian Bureau of Statistics initial analysis of the Australian Health Survey (Australian Bureau of Statistics, 2014) for comparative purposes. It should be noted that this data only includes information on unprocessed/fresh meat varieties and does not include contributions of unprocessed meats as part of mixed dishes and cannot be used to reliably estimate intakes of processed meat varieties due to the categorization methods employed (which are based around pre-set categories and do not always differentiate based on meat type). Therefore the mean intake of fresh/unprocessed pork reported from the Australian Bureau of Statistics is lower than the actual intake calculated from the raw dataset (and presented in Table 1) which included the contribution of pork from mixed dishes. This under-estimation of the mean daily intake of unprocessed meat is likely to occur across each meat category and should be taken into consideration when evaluating results. Despite these limitations, the data does suggest that the mean daily intake of pork consumption remains lower than that of other meats, particularly beef and chicken (Figure 4).



**Figure 4 - Mean daily intake of unprocessed meat types consumed by Australians in the 2011-2013 Australian Health Survey (reported by Australian Bureau of Statistics)**

When pork consumption was analysed by gender, males were found to consume significantly higher amounts of all types of pork than females (all  $p < 0.05$ ) (Appendix 3). When the analysis was restricted to pork consumers only, males consumed significantly higher amounts of total pork ( $p = 0.00$ ) and processed pork ( $p = 0.00$ ) than females (Appendix 2). In the total sample of the survey, when data

was analysed by age group, individuals in the '2 - 3 years' age group consumed the lowest amount of total pork, whilst those aged 14 - 18 years consumed the highest amount ( $p=0.00$ ) (Appendices 4 and 5). The same trend was found when data was restricted to pork consumers only.

When pork consumption was evaluated to explore intakes of particular types of pork products, ham and bacon were the pork items consumed in the greatest amounts, with a total of 57206.61 and 56153.70 grams reported to be consumed by the Australian population on the day of the survey for ham and bacon respectively. Of fresh pork varieties, pork loin was the item consumed in the greatest amount, with a total of 34584.73 grams reported to be consumed on the day of the survey.

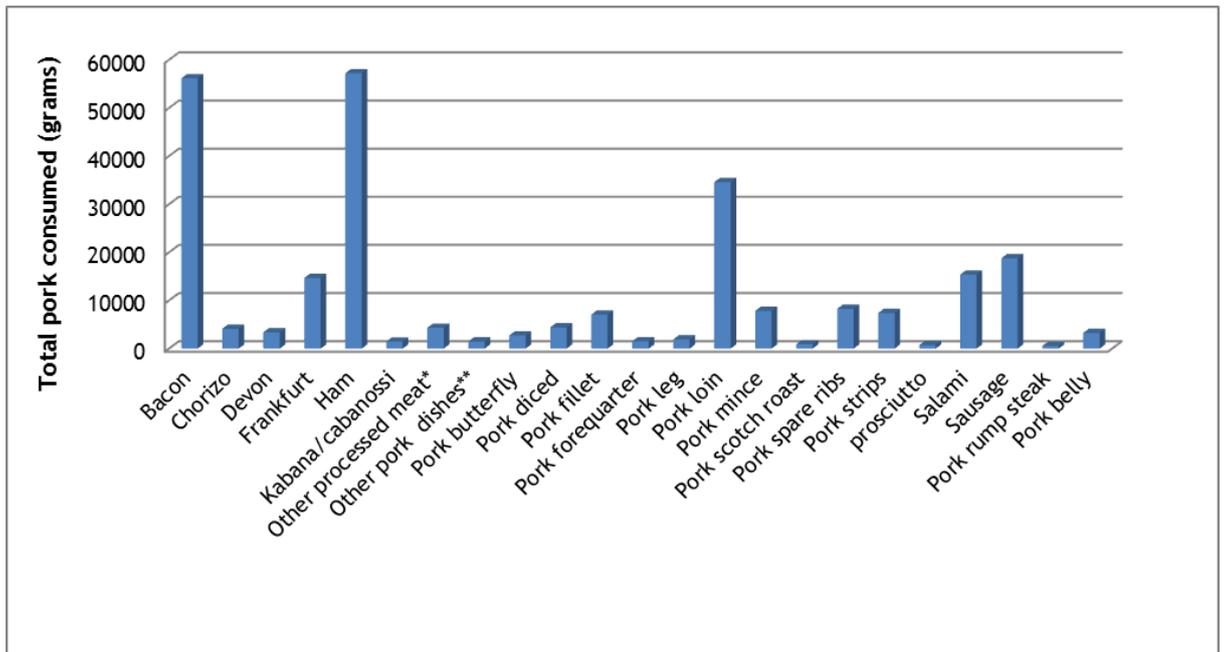
The total amount of pork containing meat varieties consumed is listed in Table 2 and Figure 5a. The average serve size of each pork meat type amongst consumers of that type of pork product is also listed in Table 2. The amount of each pork type consumed expressed as a percentage of total pork intake is listed in Figure 5b.

**Table 2 - Total and mean amount of pork containing meat varieties consumed by all Australians on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

Meat type	Total consumed (g)	Average amount consumed (g) $\pm$ Standard deviation
Bacon	56153.70	30.06 $\pm$ 29.19
Chorizo	4127.03	44.14 $\pm$ 62.21
Devon	3381.98	45.09 $\pm$ 34.27
Frankfurt	14687.43	77.71 $\pm$ 46.03
Ham	57206.61	26.07 $\pm$ 24.84
Kabana/cabanossi	1442.15	46.52 $\pm$ 33.12
Other processed meat containing pork*	4323.62	45.04 $\pm$ 37.41
Other pork containing dishes**	1484.42	59.38 $\pm$ 10.9
Pork butterfly	2734.92	130.23 $\pm$ 69.81
Pork diced	4421.36	64.08 $\pm$ 51.31
Pork fillet	7062.67	81.18 $\pm$ 88.96
Pork forequarter	1530.34	95.65 $\pm$ 111.27
Pork leg	1926.09	107.00 $\pm$ 37.29
Pork loin	34584.73	109.79 $\pm$ 63.70
Pork mince	7849.25	32.71 $\pm$ 37.4
Pork scotch roast	910.17	151.70 $\pm$ 43.41
Pork spare ribs	8272.64	172.35 $\pm$ 132.68
Pork strips	7418.43	82.43 $\pm$ 54.91
prosciutto	727.83	9.45 $\pm$ 13.15
Salami	15398.89	22.91 $\pm$ 33.70
Sausage	18758.72	60.12 $\pm$ 78.34
Pork rump steak	541.75	108.35 $\pm$ 50.84
Pork belly	3261.62	101.93 $\pm$ 83.24

\*includes Berliner, Brawn, Black pudding, Polish sausage, Liverwurst, Mortadella, Spam and Strasburg

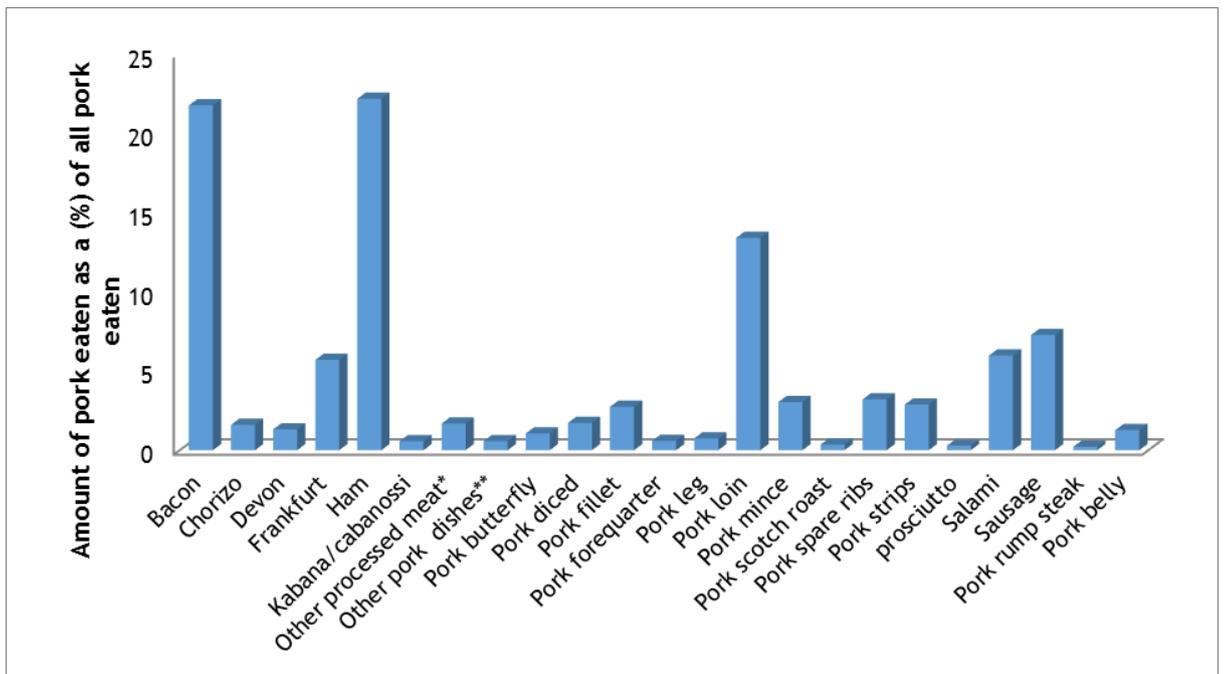
\*\*includes pickled pork, pork crackling, pork not further specified, pork rind and pork head



\*includes Berliner, Brawn, Black pudding, Polish sausage, Liverwurst, Mortadella, Spam and Strasburg

\*\*includes pickled pork, pork crackling, pork not further specified, pork rind and pork head

**Figure 5a - Total amount (in grams) of pork containing meat varieties consumed by Australians on day one of the 2011-2013 National Nutrition and Physical Activity Survey**



\*includes Berliner, Brawn, Black pudding, Polish sausage, Liverwurst, Mortadella, Spam and Strasburg, \*\*includes pickled pork, pork crackling, pork not further specified, pork rind and pork head

**Figure 5b - Types of pork consumed by Australians on day one of the 2011-2013 National Nutrition and Physical Activity Survey, displayed as a percentage of total pork eaten**

### Demographic characteristics of pork consumers and non-consumers

The demographic characteristics of pork consumers and non-consumers are shown in Table 3. Significant differences between pork consumers and non-consumers were found for all demographic characteristics examined, although differences between some groupings of income and socio-economic disadvantage categories were no longer significant when post-hoc tests were applied. Demographic characteristics of pork consumers and non-consumers are shown below in Figures 6 - 11.

Table 3 - Proportion (%) of demographic characteristics of pork consumers and non-consumers

Characteristic	Consumers (n =4501)	Non-consumers (n =7652)	Chi Squared analysis
	%	%	
<b>Gender:</b>			
- Male	53.95	47.22	$\chi^2=91310.40$ (1), p=0.00
- Female	46.05	52.78	
<b>Age group:</b>			
- 2-3 years	1.89	3.03	$\chi^2= 111122.14$ (7), p=0.00
- 4-8 years	6.52	6.29	
- 9-13 years	8.18	6.44	
- 14-18 years	6.89	5.61	
- 19-30 years	18.62	17.64	
- 31-50 years	30.21	28.42	
- 51-70 years	20.48	23.44	
- 71 years and over	7.21	9.14	
<b>Remoteness:</b>			
- Major cities of Australia	69.30	71.47	$\chi^2 =11740.05$ (2), p=0.00
- Inner regional Australia	20.75	19.10	
- Other	9.95	9.43	
<b>Country of birth</b>			
- Australia	76.16	72.22	$\chi^2=43243.72$ (2), p=0.00
- Main English speaking country	9.43	10.34	
- Other	14.41	17.44	
<b>SEIFA (Index of Relative Socio-Economic Disadvantage)</b>			
- Lowest 20% <sup>b</sup> (highest disadvantage)	18.61	17.50	$\chi^2=38523.06$ (4), p=0.00
- Second quintile	17.68	21.08	
- Third quintile	21.29	20.39	
- Fourth quintile <sup>b</sup>	19.61	18.44	
- Highest 20% (lowest disadvantage)	22.79	22.59	
<b>Equivalentised income of household<sup>a</sup></b>			
- First decile	10.09	11.59	$\chi^2= 68591.04$ (9), p= 0.00
- Second decile	6.62	8.52	
- Third decile	8.25	9.80	
- Fourth decile <sup>c</sup>	10.10	8.84	
- Fifth decile	12.25	11.54	
- Sixth decile	10.28	9.30	
- Seventh decile	11.44	11.97	
- Eighth decile	10.58	9.35	
- Ninth decile <sup>c</sup>	10.07	8.87	
- Tenth decile	10.31	10.22	

<sup>a</sup>Excluding n=1253 (not stated/not known)

<sup>b</sup> No significant difference found between consumers and non-consumers in post-hoc analysis ( $\chi^2= 0.08$ (1), p=0.78), <sup>c</sup> No significant difference found between consumers and non-consumers in post-hoc analysis ( $\chi^2= 6.41$ (1), p=0.01)

The proportion of male and female pork consumers and non-consumers is shown in Figure 6. A significantly higher proportion of pork consumers were males, whilst individuals who did not consume pork were more likely to be females.

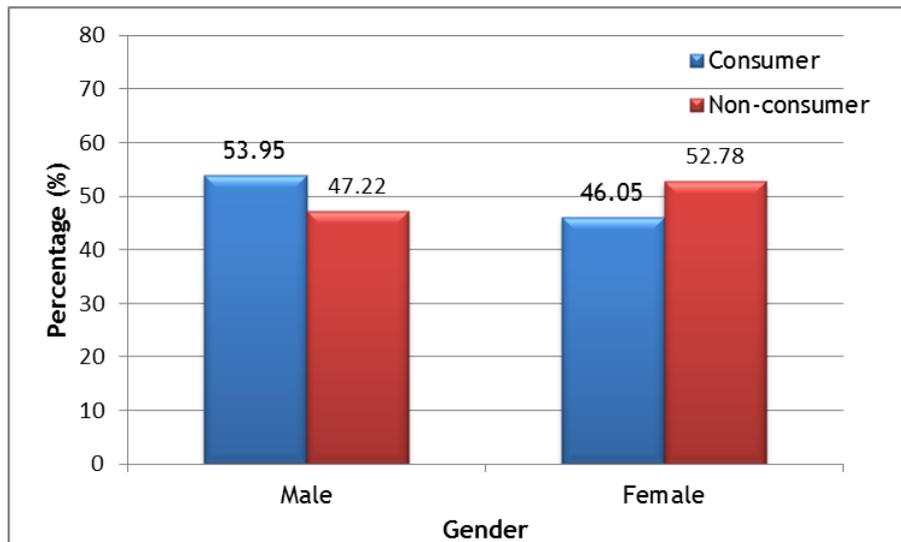


Figure 6 - Percentage (%) of male and female pork consumers and non-consumers in day one of the 2011-2013 National Nutrition and Physical Activity Survey.

The age groups of pork consumers and non-consumers is shown in Figure 7. Significantly higher proportions of individuals who consumed pork were aged 4 - 50 years than those who were aged 2 -3 years, or over 51 years (all  $p < 0.001$ ).

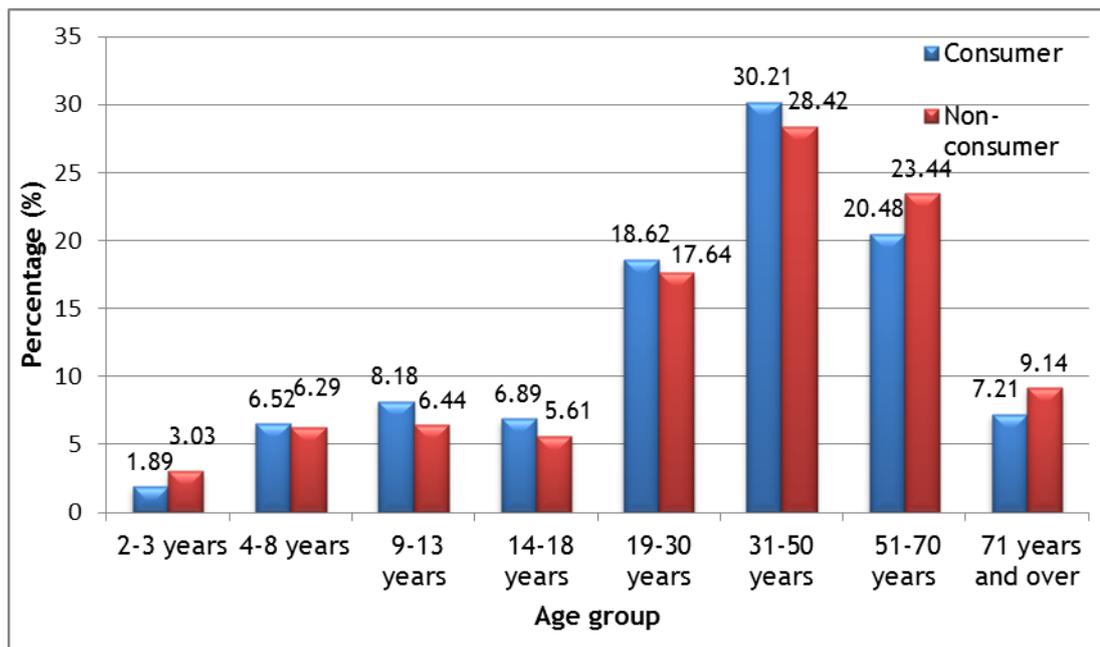


Figure 7 - Percentage (%) of pork consumers and non-consumers in each age group on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of pork consumers and non-consumers in each category of remoteness is shown in Figure 8. Whilst statistically significant differences were found between each category of remoteness, the differences between the proportion of consumers and non-consumers were small, and are likely to be influenced by the large sample size of the data.

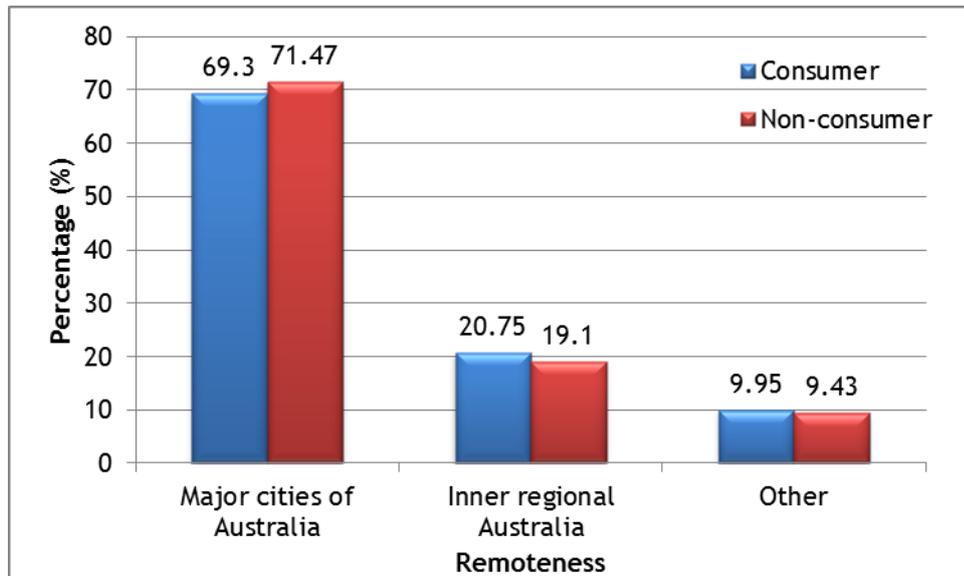


Figure 8. Percentage (%) of pork consumers and non-consumers by remoteness on day one of the 2011-2013 National Nutrition and Physical Activity Survey

Figure 9 shows the country of birth for pork consumers and non-consumers. Pork consumers were more likely to be born in Australia than in another country, including another English speaking country such as the United States, the United Kingdom, New Zealand or Canada; or other countries (main English speaking country:  $\chi^2=9205.63$  (1),  $p=0.00$ ; other country:  $\chi^2=38495.04$  (1),  $p=0.00$ ).

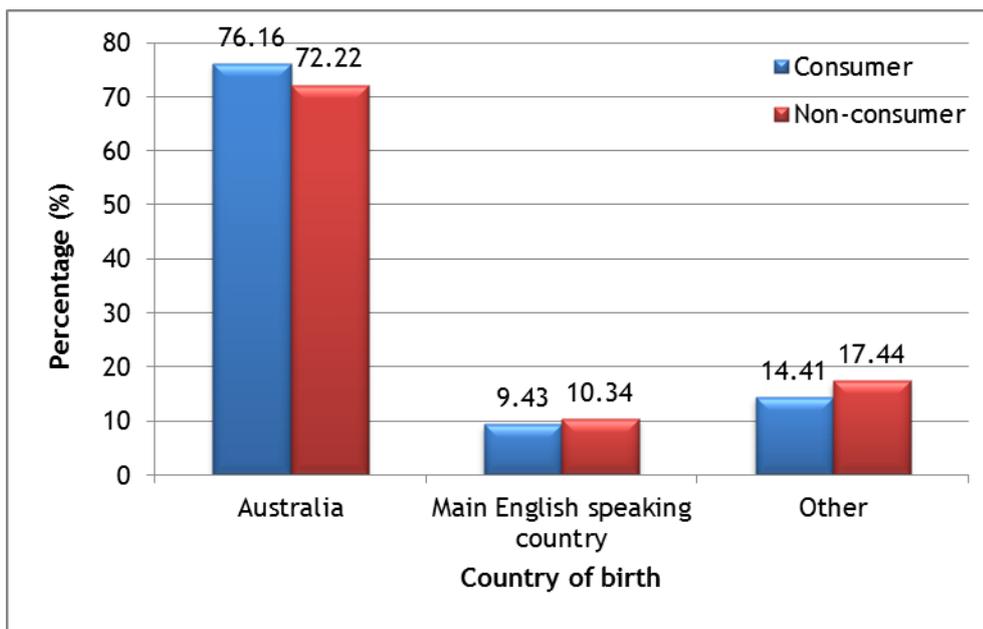


Figure 9 - Percentage (%) of pork consumers and non-consumers by country of birth on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of pork consumers and non-consumers as categorised by the Index of Relative Socio-Economic Disadvantage is shown in Figure 10 (where the lowest quintile indicates the greatest socio-economic disadvantage). Proportions of consumers and non-consumers were significantly different between all quintiles, with the exception of the comparison between the lowest 20% and the fourth quintile ( $\chi^2= 0.08$ (1),  $p=0.78$ ). Whilst significant differences were identified, it should be noted that no clear trend across quintiles of socio-economic disadvantage were found, and differences between the proportion of consumers

and non-consumers were small, suggesting there was a limited relationship between pork consumption and this parameter.

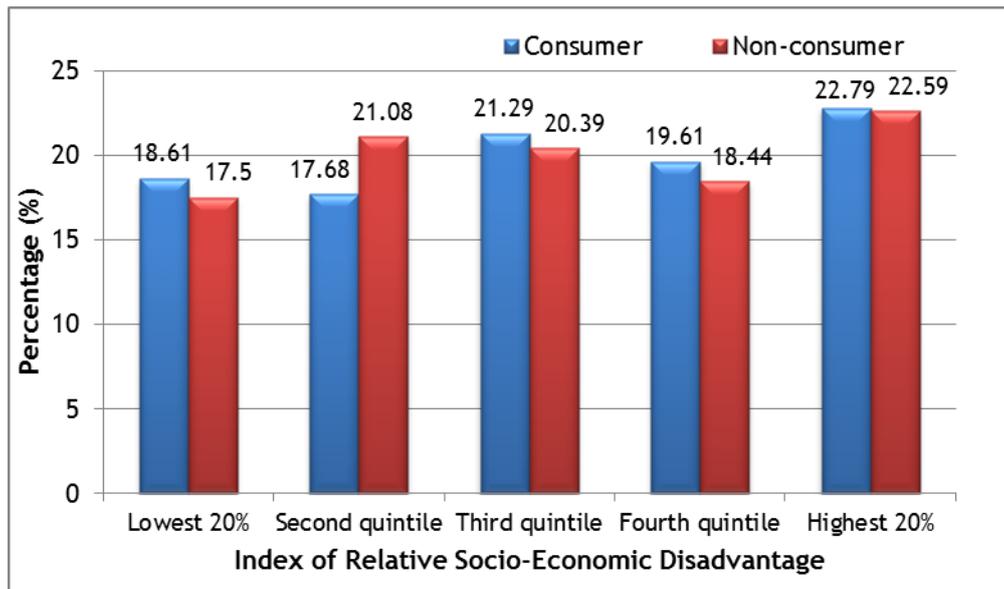


Figure 10 - Percentage (%) of pork consumers and non-consumers by Index of Relative Socio-Economic Disadvantage on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of pork consumers and non-consumers as categorised by the Equivalised Income of Household is shown in Figure 11. Proportions of consumers and non-consumers were significantly different between all deciles of income, with the exception of the comparison between the fourth and ninth decile ( $\chi^2=6.41(1)$ ,  $p=0.01$ ). As with the Index of Relative Socio-Economic Disadvantage, differences in the proportion of pork consumers and non-consumers in each decile were relatively small, with a lack of clear trend found across income deciles.

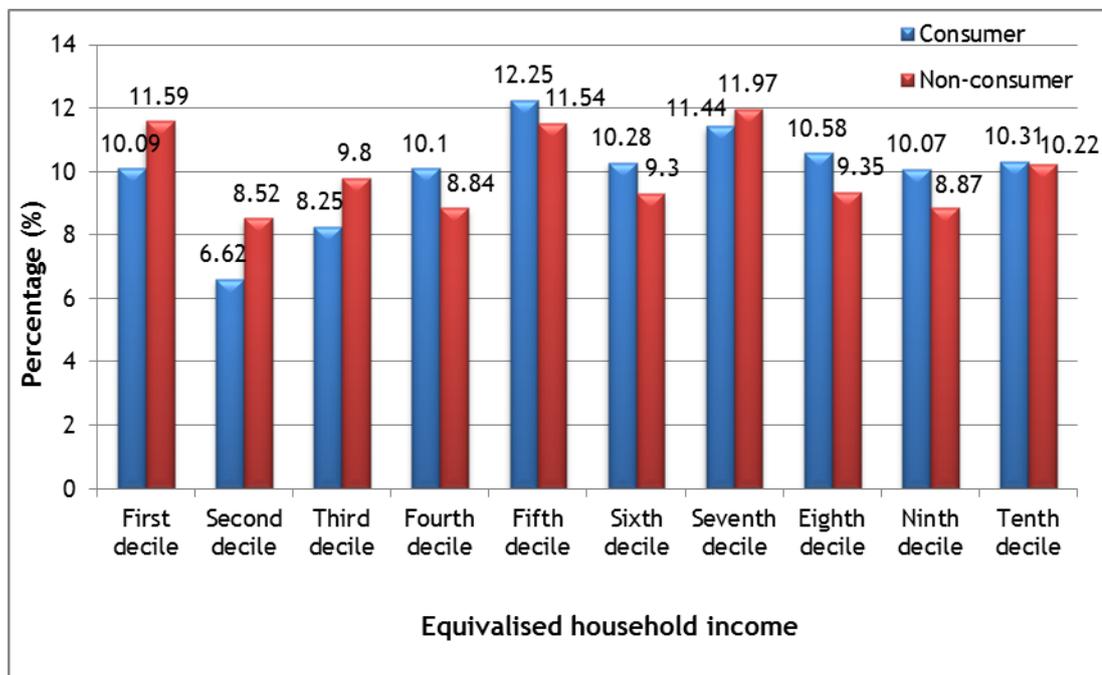
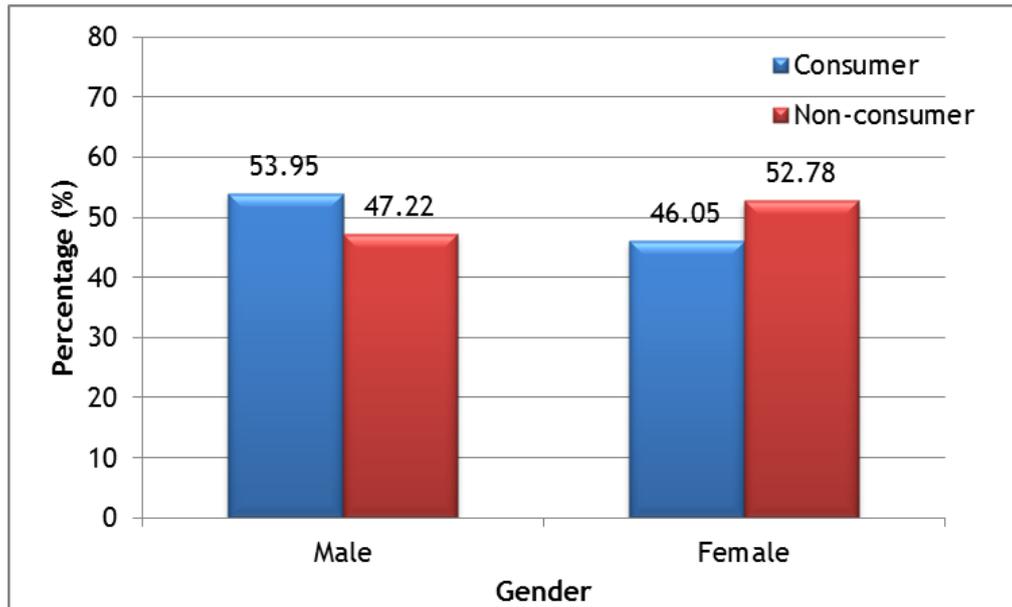


Figure 11 - Percentage (%) of pork consumers and non-consumers by Equivalised Household Income on day one of the 2011-2013 National Nutrition and Physical Activity Survey

### ***Demographic characteristics of fresh pork consumers and non-consumers***

A quantitative analysis of the demographic characteristics of fresh pork consumers and non-consumers can be found in Appendix 6. Significant differences between fresh pork consumers and non-consumers were found for all demographic characteristics examined, although differences between some groupings of socio-economic disadvantage categories were no longer significant when post-hoc tests were applied. Demographic characteristics of fresh pork consumers and non-consumers are also shown in Figures 12 - 17.

The proportion of male and female fresh pork consumers and non-consumers is shown in Figure 12. As with total pork consumption, a significantly higher proportion of fresh pork consumers were males, whilst individuals not consuming fresh pork were more likely to be females.



**Figure 12 - Percentage (%) of male and female fresh pork consumers and non-consumers on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

The age groups of fresh pork consumers and non-consumers is shown in Figure 13. Similar consumption patterns were seen to total pork, with significantly higher proportions of individuals who consumed pork being aged 4 - 50 years, compared to those aged 2 -3 years, or over 51 years (all  $p < 0.001$ ). Fresh pork consumers were thus less likely to be aged 2 -3 years or over 51 years of age.

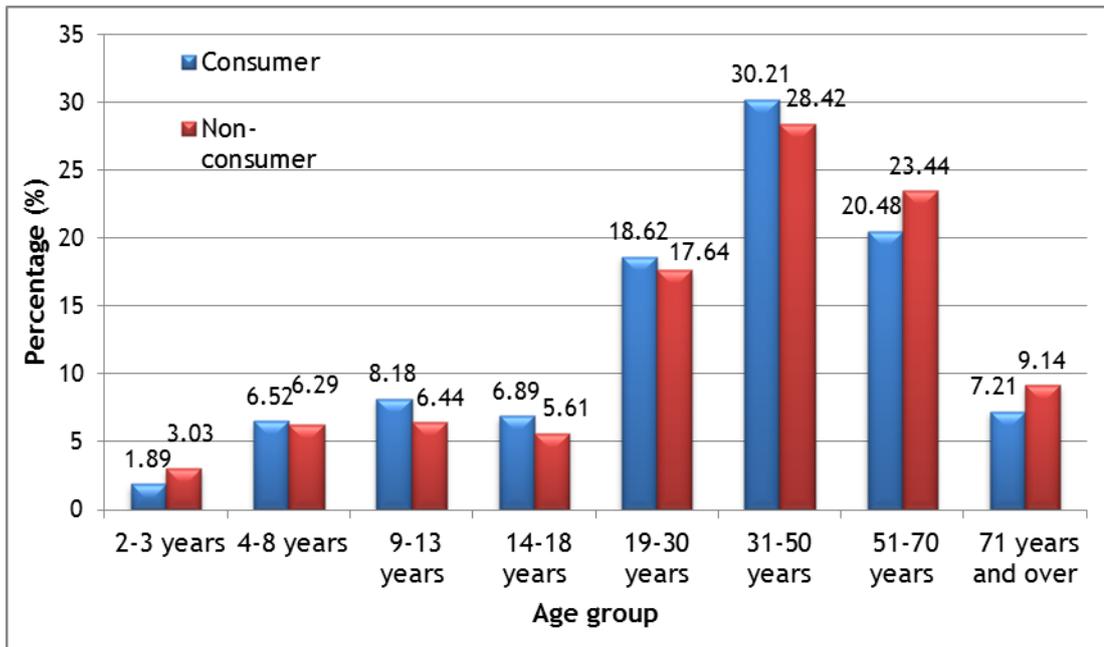


Figure 13 - Percentage (%) of fresh pork consumers and non-consumers in each age group on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of fresh pork consumers and non-consumers in each category of remoteness is shown in Figure 14. A significantly higher proportion of individuals who consumed fresh pork lived in the major cities of Australia, in comparison to inner regional Australia ( $\chi^2=43026.67$  (1),  $p=0.00$ ) or other areas ( $\chi^2=31154.24$  (1),  $p=0.00$ ).

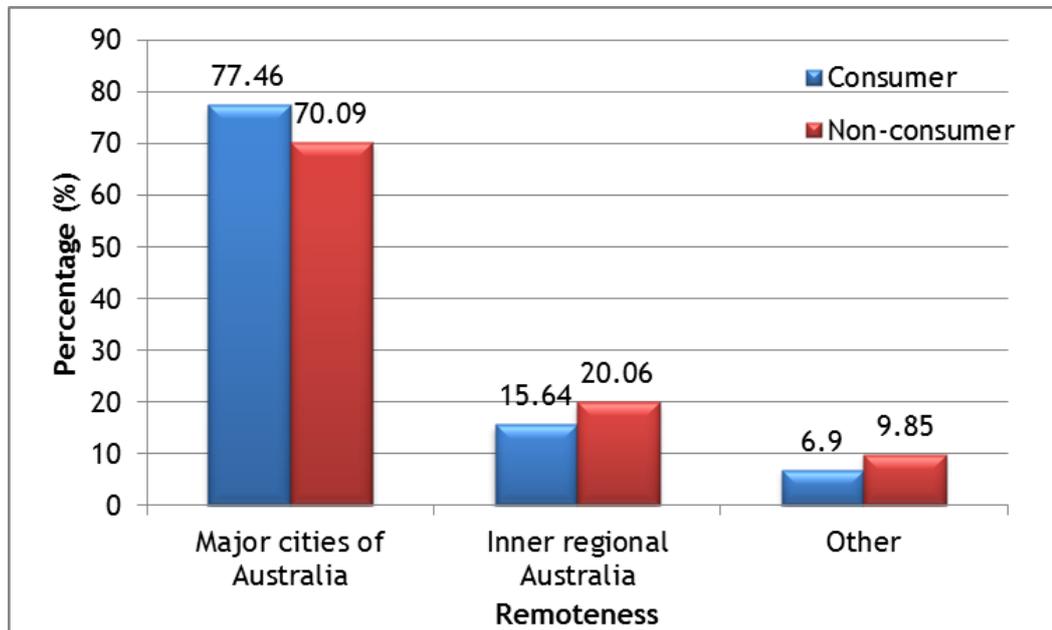
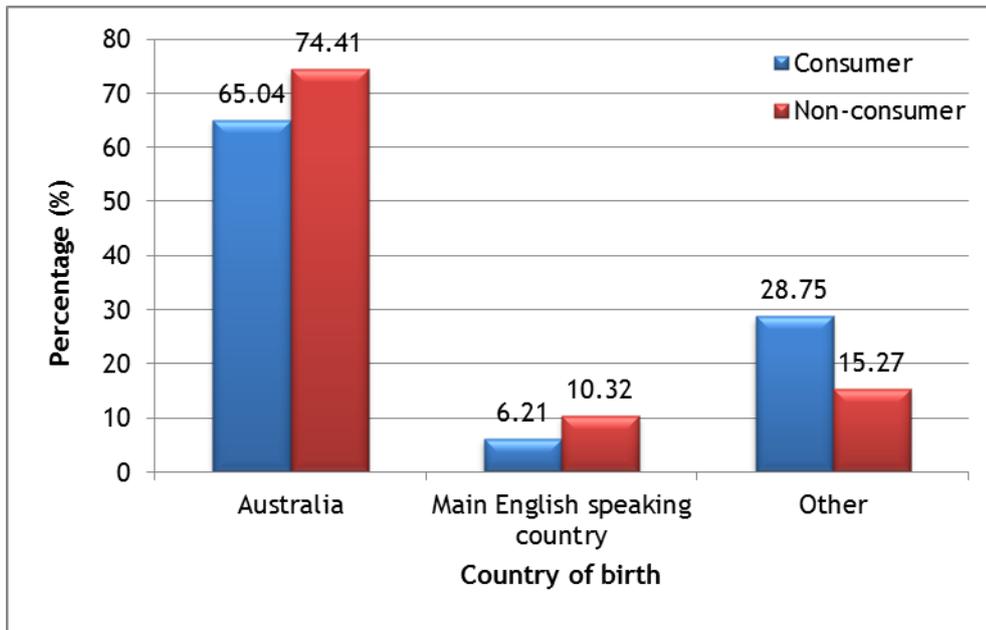


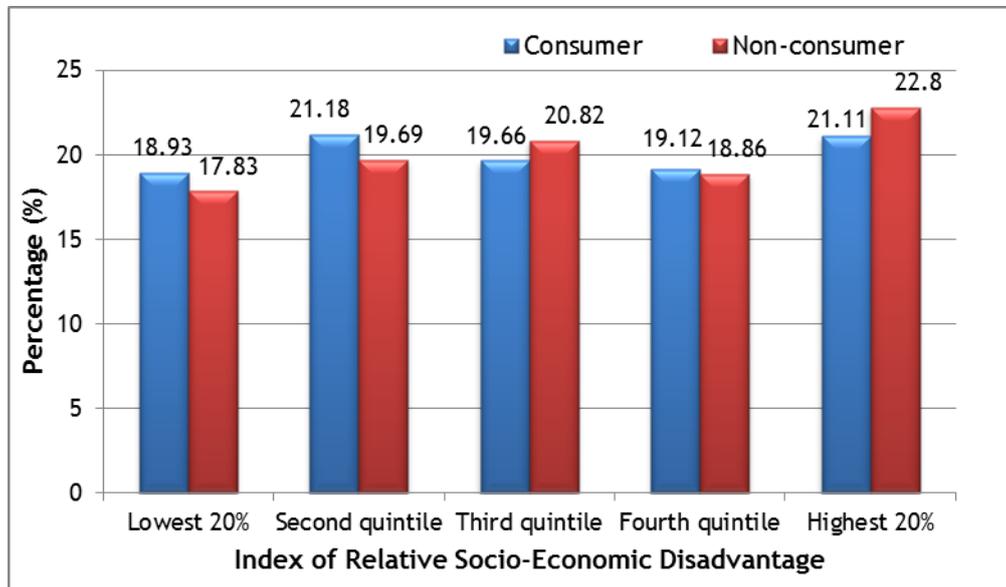
Figure 14 - Percentage (%) of fresh pork consumers and non-consumers by remoteness on day one of the 2011-2013 National Nutrition and Physical Activity Survey

Figure 15 shows the country of birth for fresh pork consumers and non-consumers. A significantly higher proportion of fresh pork consumers were born in a non-English speaking country, in comparison to Australia ( $\chi^2=320925.35$  (1),  $p=0.00$ ) or a main English speaking country such as the United Kingdom, the United States, New Zealand or Canada ( $\chi^2=164816.70$  (1),  $p=0.00$ ).



**Figure 15 - Percentage (%) of fresh pork consumers and non-consumers by country of birth on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

The proportion of fresh pork consumers and non-consumers as categorised by the Index of Relative Socio-Economic Disadvantage is shown in Figure 16. Proportions of consumers and non-consumers were significantly different between all quintiles, with the exception of the comparison between the third and the fifth quintile ( $\chi^2 = 2.04(1)$ ,  $p = 0.15$ ). As with total pork, no clear trend across quintiles of socio-economic disadvantage were found, and differences between the proportion of consumers and non-consumers were small, suggesting there was a limited relationship between fresh pork consumption and this parameter.



**Figure 16 - Percentage (%) of fresh pork consumers and non-consumers by Index of Relative Socio-Economic Disadvantage on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

The proportion of fresh pork consumers and non-consumers as categorised by the Equivalised Income of Household is shown in Figure 17. Significant differences in the proportion of consumers and non-consumers were found between each income decile. As with total pork, differences in the proportion of pork consumers and

non-consumers in each decile were relatively small, with a lack of clear trend found across income deciles.

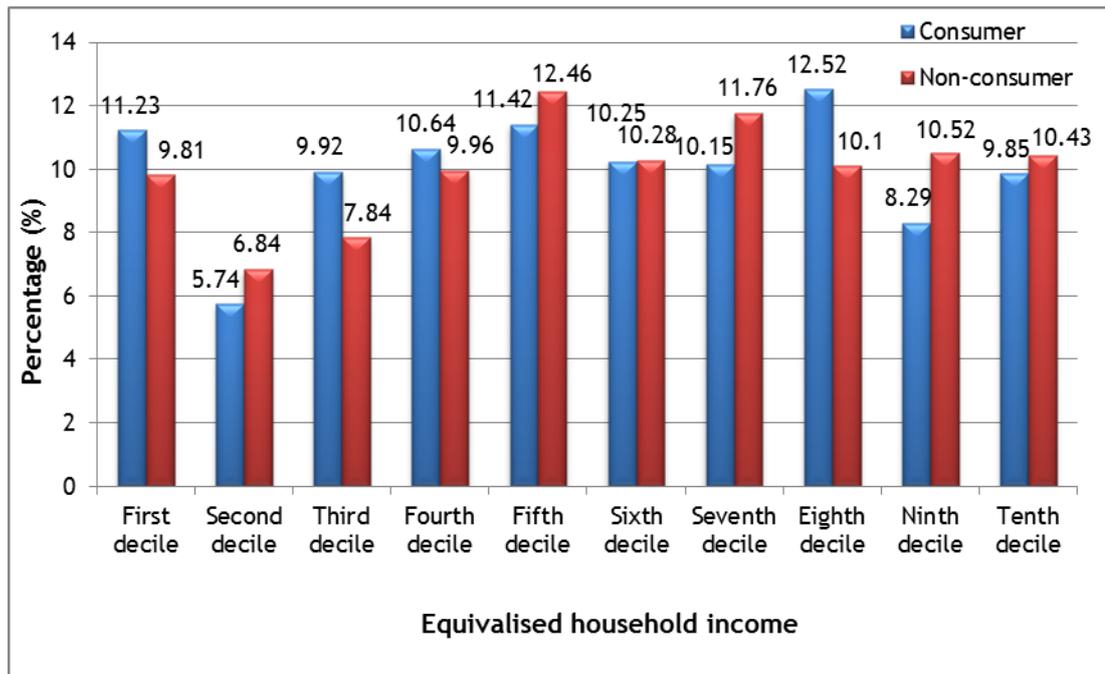


Figure 17 - Percentage (%) of fresh pork consumers and non-consumers by Equivalised Household Income on day one of the 2011-2013 National Nutrition and Physical Activity Survey

***Demographic characteristics of processed pork consumers and non-consumers***

A quantitative analysis of the demographic characteristics of processed pork consumers and non-consumers can be found in Appendix 7. Significant differences between processed pork consumers and non-consumers were found for all demographic characteristics examined. Demographic characteristics of processed pork consumers and non-consumers are also shown in Figures 18 - 23.

The proportion of male and female processed pork consumers and non-consumers is shown in Figure 18. Similar trends were found to those for total and fresh pork consumption, where a significantly higher proportion of processed pork consumers were males. It should be noted however, that the absolute difference in the proportion of processed pork consumers and non-consumers for each gender were less than for other types of pork.

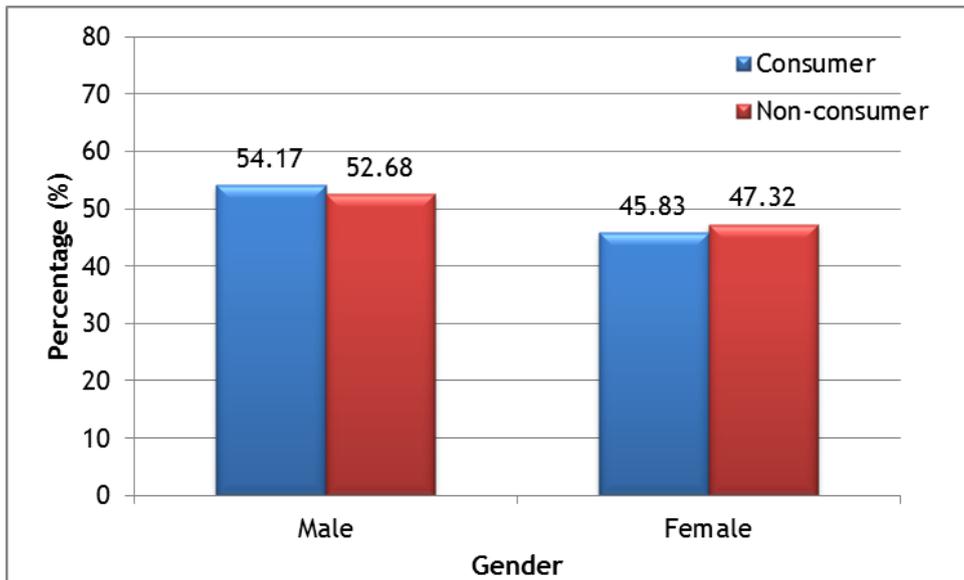


Figure 18 - Percentage (%) of male and female processed pork consumers and non-consumers on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The age groups of processed pork consumers and non-consumers is shown in Figure 19. Significantly higher proportions of individuals who consumed processed pork were aged 2 - 18 years, compared to those aged over 19 years (all  $p < 0.001$ ), suggesting younger individuals were more likely to be pork consumers than those above 19 years of age.

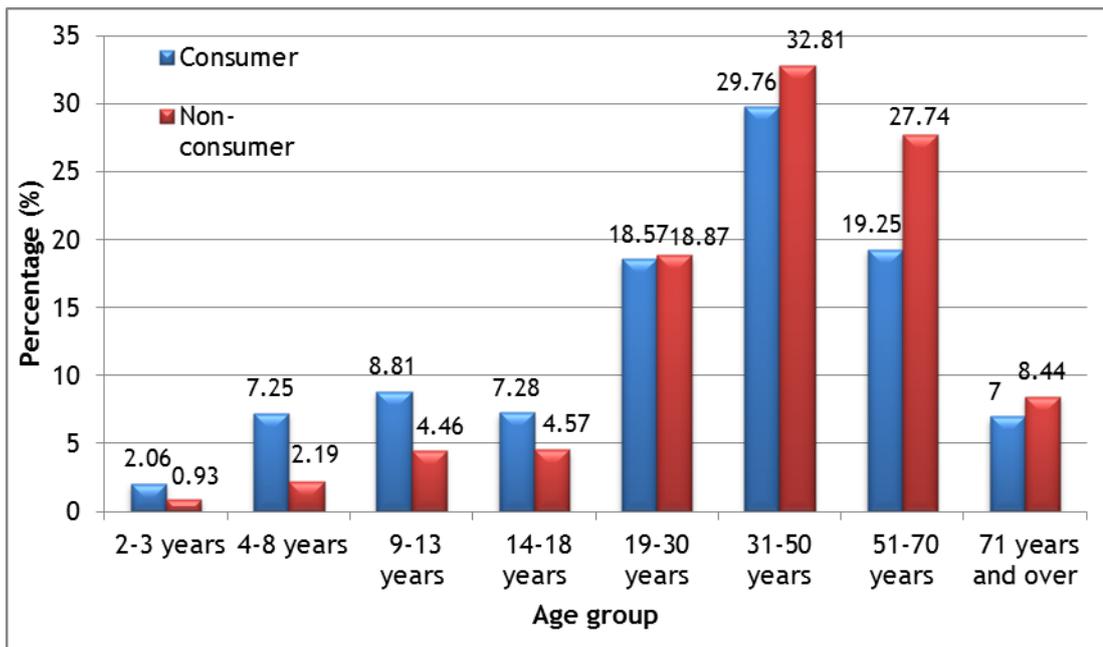


Figure 19 -Percentage (%) of processed pork consumers and non-consumers in each age group on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of processed pork consumers and non-consumers in each category of remoteness is shown in Figure 20. A significantly lower proportion of individuals who consumed processed pork lived in the major cities of Australia, in comparison to inner regional Australia ( $\chi^2 = 26965.12$  (1),  $p = 0.00$ ) or other areas ( $\chi^2 = 41462.68$  (1),  $p = 0.00$ ).

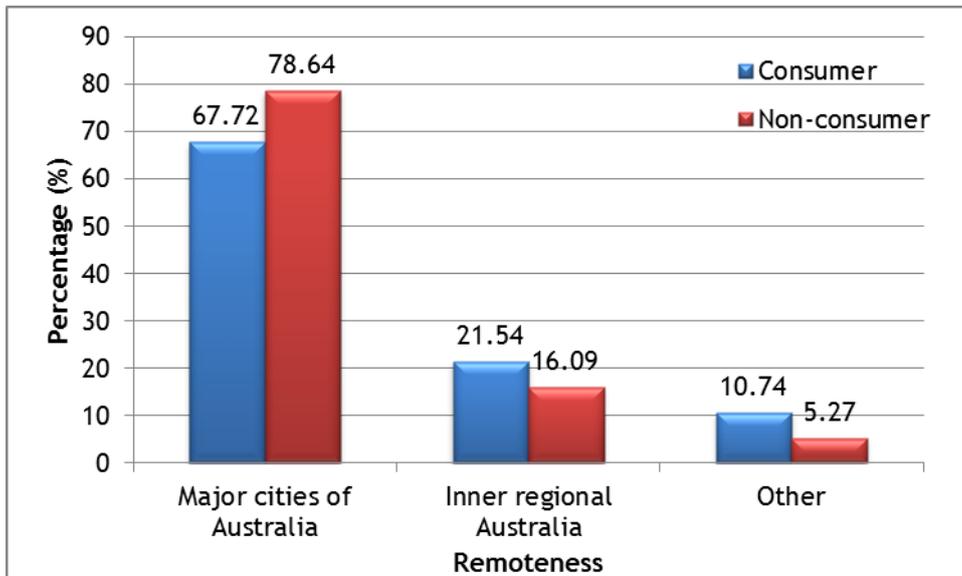


Figure 20 - Percentage (%) of processed pork consumers and non-consumers by remoteness on day one of the 2011-2013 National Nutrition and Physical Activity Survey

Figure 21 shows the country of birth for processed pork consumers and non-consumers. A significantly lower proportion of processed pork consumers were born in a non-English speaking country, in comparison to Australia ( $\chi^2=355109.92$  (1),  $p=0.00$ ) or a main English speaking country (eg. the United States, United Kingdom, Canada or New Zealand) ( $\chi^2=160285.78$  (1),  $p=0.00$ ).

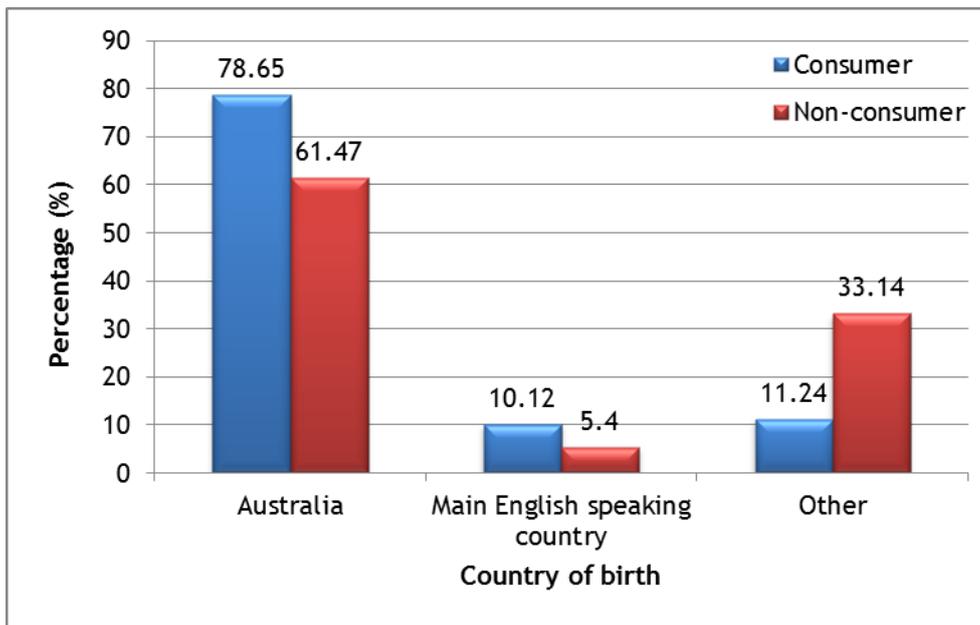


Figure 21 - Percentage (%) of processed pork consumers and non-consumers by country of birth on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of processed pork consumers and non-consumers as categorised by the Index of Relative Socio-Economic Disadvantage is shown in Figure 22. Significant differences in the proportion of consumers and non-consumers were found between each quintile, however as with fresh and total pork, no clear trend across quintiles was found.

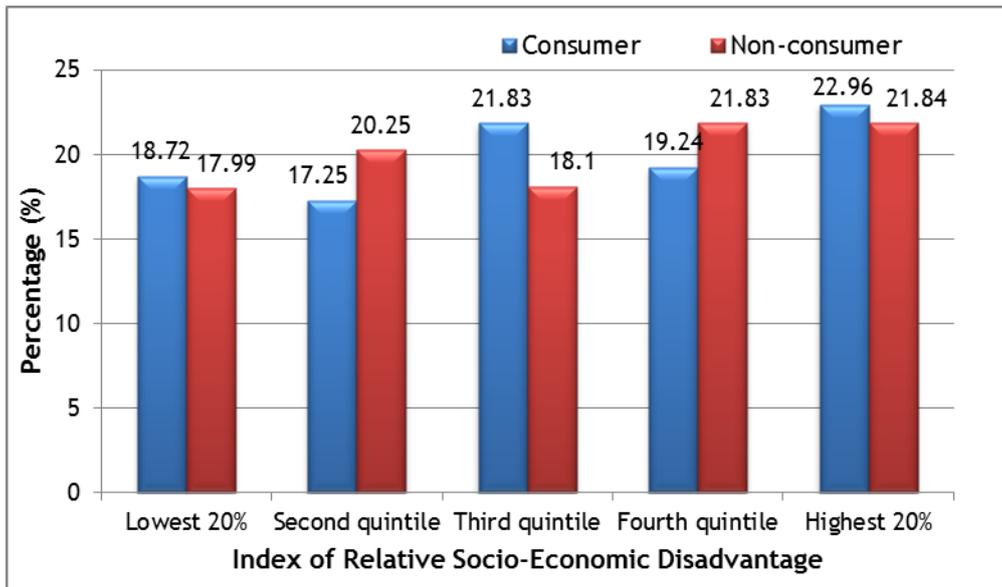


Figure 22 - Percentage (%) of processed pork consumers and non-consumers by Index of Relative Socio-Economic Disadvantage on day one of the 2011-2013 National Nutrition and Physical Activity Survey

The proportion of processed pork consumers and non-consumers as categorised by the Equivalised Income of Household is shown in Figure 23. Significant differences in the proportion of consumers and non-consumers were found in each income decile, however a lack of a clear trend across deciles was found.

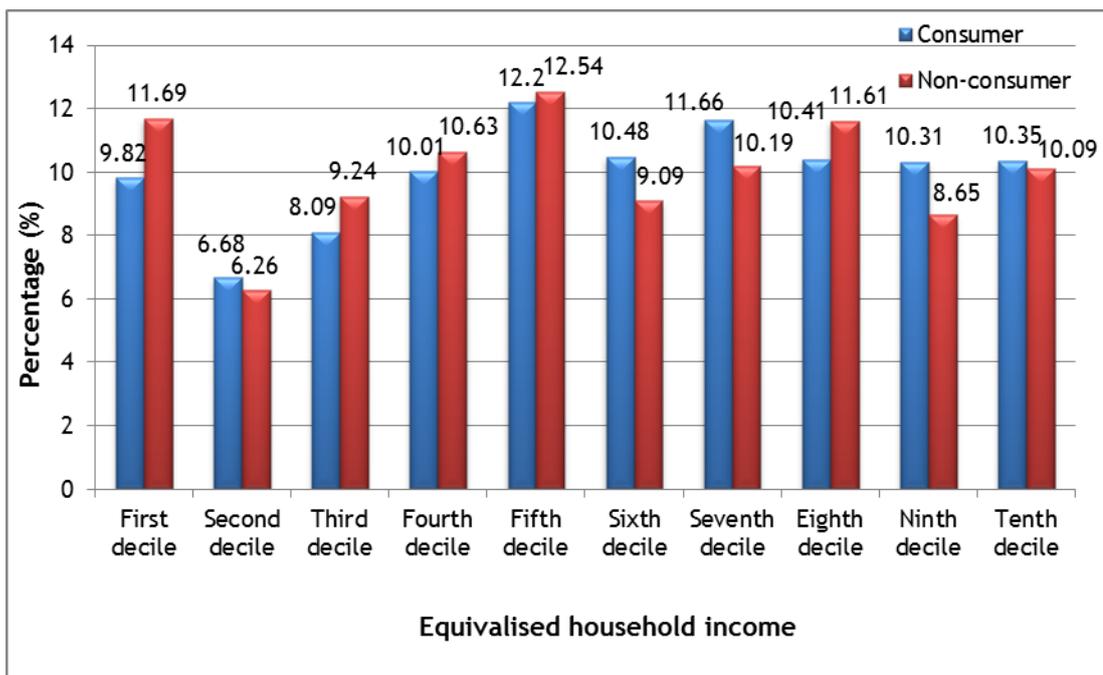


Figure 23 - Percentage (%) of processed pork consumers and non-consumers by Equivalised Household Income on day one of the 2011-2013 National Nutrition and Physical Activity Survey

### ***Nutritional profiles associated with pork consumption***

A comparison of nutrient consumption between pork consumers and non-consumers, after adjusting for total energy intake, is shown in Table 4. Whilst pork consumers had significantly higher intakes of energy, total fat, saturated fat, cholesterol and sodium, they also consumed significantly higher amounts of protein, fibre, thiamin, monounsaturated fat, iodine, and selenium than non-

consumers. Pork consumers also had slightly, but significantly higher niacin intakes than non-consumers (mean 0.54mg higher).

**Table 4 - Mean  $\pm$  standard deviation and median (interquartile range) nutrient intakes in pork consumers and non-consumers (adjusted for energy intake)**

	Consumer (n = 4501)		Non-consumer (n =7652)		P-value*
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	
Energy (kJ)	9142.77 $\pm$ 3714.33	8613.21 (6497.34 - 11064.57)	8151.52 $\pm$ 3474.82	7660.34 (5705.99 - 10021.92)	0
Protein (g)	88.68 $\pm$ 28.42	85.33 (71.89 - 101.67)	86.79 $\pm$ 29.46	83.21 (69.13 - 100.57)	0
Total fat (g)	74.54 $\pm$ 23.20	73.84 (62.50 - 85.32)	71.76 $\pm$ 19.80	72.10 (61.25 - 82.48)	0
Sugar (g)	100.98 $\pm$ 52.66	99.11 (69.97 - 128.90)	107.36 $\pm$ 48.30	103.77 (78.66 - 131.20)	0
Carbohydrate (g)	216.86 $\pm$ 63.06	221.14 (185.86 - 254.09)	226.29 $\pm$ 55.96	226.92 (195.24 - 257.79)	0
Fibre (g)	45.53 $\pm$ 6.63	44.58 (40.80 - 48.95)	43.76 $\pm$ 6.20	42.88 (39.39 - 47.09)	0
Iron (mg)	10.34 $\pm$ 4.19	9.84 (7.75 - 12.23)	11.09 $\pm$ 4.45	10.37 (8.40 - 13.04)	0
Thiamin (mg)	1.63 $\pm$ 1.09	1.38 (1.02 - 1.98)	1.52 $\pm$ 1.11	1.24 (0.93 - 1.76)	0
Saturated fat (g)	29.34 $\pm$ 11.47	28.71 (22.57 - 34.96)	27.22 $\pm$ 10.60	26.85 (21.09 - 32.83)	0
MUFA (g) <sup>□</sup>	28.47 $\pm$ 11.44	27.41 (22.37 - 33.21)	27.20 $\pm$ 10.04	26.63 (21.89 - 31.66)	0
PUFA (g) <sup>□□</sup>	10.48 $\pm$ 5.92	9.65 (7.22 - 12.65)	11.14 $\pm$ 5.87	10.13 (7.73 - 13.25)	0
n-3 PUFA (mg) <sup>□□□</sup>	212.92 $\pm$ 632.01	110.10 (61.19 - 183.12)	270.35 $\pm$ 692.59	119.01 (64.08 - 221.71)	0
Cholesterol (mg)	315.47 $\pm$ 228.89	248.34 (178.93 - 379.05)	268.18 $\pm$ 192.93	229.28 (163.32 - 315.23)	0
Riboflavin (mg)	1.79 $\pm$ 1.03	1.63 (1.15 - 2.23)	1.95 $\pm$ 1.05	1.78 (1.30 - 2.37)	0
Niacin (mg)	39.96 $\pm$ 14.74	37.80 (30.97 - 46.35)	39.42 $\pm$ 14.95	37.24 (30.17 - 46.39)	0
Vitamin B6 (mg)	1.38 $\pm$ 1.25	1.18 (0.91 - 1.56)	1.43 $\pm$ 1.22	1.26 (0.98 - 1.63)	0
Vitamin B12 (ug)	4.33 $\pm$ 3.89	3.83 (2.66 - 5.31)	4.43 $\pm$ 3.62	3.97 (2.80 - 5.46)	0
Phosphorous (mg)	1419.07 $\pm$ 392.96	1384.06 (1193.48 - 1601.66)	1424.12 $\pm$ 423.16	1382.06 (1176.16 - 1629.36)	0
Magnesium (mg)	303.41 $\pm$ 97.72	293.24 (240.85 - 351.40)	330.23 $\pm$ 107.69	312.72 (259.47 - 379.37)	0
Zinc (mg)	10.38 $\pm$ 4.25	9.74 (7.91 - 11.94)	10.69 $\pm$ 5.19	9.59 (7.88 - 12.24)	0
Potassium (mg)	2667.27 $\pm$ 878.97	2610.25 (2115.44 - 3128.05)	2878.64 $\pm$ 894.02	2780.83 (2289.75 - 3386.21)	0
Iodine (ug)	174.85 $\pm$ 77.81	167.61 (125.47 - 214.10)	169.73 $\pm$ 73.23	161.94 (124.36 - 206.64)	0
Selenium (ug)	87.48 $\pm$ 49.60	78.41 (62.91 - 101.45)	84.87 $\pm$ 54.76	74.56 (59.26 - 97.89)	0
Sodium (mg)	2749.63 $\pm$ 1169.36	2609.85 (2049.01 - 3303.24)	2198.07 $\pm$ 945.73	2112.41 (1625.78 - 2665.10)	0

<sup>□</sup>Monounsaturated fat <sup>□□</sup>Polyunsaturated fat <sup>□□□</sup>Long chain omega 3 polyunsaturated fatty acids  
\*independent samples t-test to compare nutrient intakes between pork consumers and non-consumers

A comparison of nutrient intake between fresh pork consumers and non-consumers, after adjusting for total energy intake, is shown in Table 5. Fresh pork

consumers also had significantly higher intakes of energy, total fat and cholesterol than non-consumers, but consumed less saturated fat and sodium than individuals not eating fresh pork. Fresh pork consumers also consumed significantly higher amounts of protein, monounsaturated fat, polyunsaturated fat, fibre, thiamin, niacin, vitamin B6, potassium and selenium than non-consumers.

**Table 5 - Mean + standard deviation and median (interquartile range) nutrient intakes in fresh pork consumers and non-consumers (adjusted for energy intake)**

	Consumer (n = 852)		Non-consumer (n =11 301)		p-value*
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	
Energy (kJ)	9460.55 + 4180.41	8683.97 (6498.66 - 11389.27)	8444.15 + 3534.36	7944.41 (5928.77 - 10355.56)	0
Protein (g)	97.50 + 35.50	93.70 (76.26 - 113.85)	86.66 + 28.33	83.33 (69.85 - 99.95)	0
Total fat (g)	76.23 + 29.72	73.48 (60.98 - 85.26)	72.51 + 20.28	72.71 (61.79 - 83.30)	0
Sugar (g)	91.92 + 52.58	92.23 (63.57 - 118.90)	106.06 + 49.71	103.24 (76.50 - 131.11)	0
Carbohydrate (g)	206.53 + 72.92	214.22 (175.22 - 249.70)	224.12 + 57.36	225.69 (193.32 - 257.24)	0
Fibre (g)	46.09 + 7.46	44.71 (40.81 - 49.53)	44.28 + 6.31	43.39 (39.79 - 47.69)	0
Iron (mg)	10.15 + 4.30	9.75 (7.52 - 12.18)	10.87 + 4.37	10.20 (8.21 - 12.78)	0
Thiamin (mg)	1.89 + 1.08	1.67 (1.18 - 2.36)	1.53 + 1.10	1.27 (0.94 - 1.79)	0
Saturated fat (g)	27.57 + 12.47	25.85 (20.00 - 33.53)	28.05 + 10.85	27.56 (21.71 - 33.74)	0
MUFA (g) <sup>□</sup>	30.73 + 15.86	27.88 (22.76 - 35.23)	27.42 + 10.00	26.87 (21.98 - 32.04)	0
PUFA (g) <sup>□□</sup>	11.67 + 6.90	10.39 (7.75 - 13.65)	10.83 + 5.80	9.92 (7.54 - 12.93)	0
n-3 PUFA (mg) <sup>□□□</sup>	281.90 + 1165.83	110.23 (65.36 - 185.20)	246.11 + 612.01	115.87 (62.88 - 207.78)	0
Cholesterol (mg)	309.66 + 208.34	254.11 (183.54 - 376.56)	283.89 + 208.26	234.97 (168.12 - 335.62)	0.03
Riboflavin (mg)	1.64 + 0.86	1.53 (1.13 - 2.02)	1.91 + 1.06	1.74 (1.26 - 2.35)	0
Niacin (mg)	44.88 + 16.73	42.81 (34.39 - 53.26)	39.18 + 14.62	37.05 (30.30 - 45.77)	0
Vitamin B6 (mg)	1.51 + 0.90	1.38 (1.38 - 1.81)	1.41 + 1.25	1.22 (0.94 - 1.59)	0
Vitamin B12 (ug)	3.81 + 2.61	3.33 (2.28 - 4.66)	4.44 + 3.80	3.96 (2.81 - 5.44)	0
Phosphorous (mg)	1394.92 + 424.86	1358.25 (1158.23 - 1610.27)	1424.51 + 410.97	1384.21 (1185.89 - 1384.21)	0
Magnesium (mg)	308.97 + 102.19	302.88 (247.85 - 362.66)	321.13 + 105.04	305.47 (253.21 - 369.95)	0
Zinc (mg)	10.52 + 4.64	9.82 (7.85 - 12.22)	10.58 + 12.47	9.63 (7.90 - 12.11)	0
Potassium (mg)	2922.24 + 998.97	2901.92 (2361.19 - 3455.39)	2789.33 + 884.23	2695.46 (2217.19 - 3280.75)	0
Iodine (ug)	144.12 + 69.81	139.30 (102.55 - 182.57)	173.94 + 4.30	165.95 (165.95 - 211.28)	0
Selenium (ug)	94.03 + 45.45	86.80 (66.61 - 114.61)	85.17 + 53.42	75.49 (60.50 - 97.69)	0
Sodium (mg)	2393.26 + 1551.26	2123.62 (1648.30 - 2979.51)	2405.36 +1018.44	2290.98 (1762.80 - 2919.83)	0

<sup>□</sup>Monounsaturated fat <sup>□□</sup>Polyunsaturated fat <sup>□□□</sup>Long chain omega 3 polyunsaturated fatty acids

\*independent samples t-test to compare nutrient intakes between pork consumers and non-consumers

A comparison of nutrient consumption between processed pork consumers and non-consumers, after adjusting for total energy intake, is shown in Table 6. Processed pork consumers had significantly higher intakes of energy, total fat, saturated fat, cholesterol and sodium. Processed pork consumers also consumed significantly higher amounts of fibre, monounsaturated fat, iodine, and selenium than non-consumers. Thiamin intake was also significantly higher in processed pork consumers, however the small difference between consumers and non-consumers (consumers: 1.59mg versus non-consumers: 1.54mg) means this difference is unlikely to be of clinical significance.

**Table 6 - Mean  $\pm$  standard deviation and median (interquartile range) nutrient intakes in processed pork consumers and non-consumers (adjusted for energy intake)**

	Consumer (n = 3893)		Non-consumer (n =8260)		p-value*
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	
Energy (kJ)	9132.31 + 3643.64	8652.55 (6542.72 - 11083.39)	8235.39 + 3540.79	7727.56 (5765.60 - 10074.59)	0
Protein (g)	87.06 + 26.20	84.11 (71.51 - 100.04)	87.70 + 30.36	84.02 (69.54 - 101.60)	0
Total fat (g)	74.49 + 21.93	74.03 (62.90 - 85.46)	72.00 + 20.77	72.07 (61.12 - 82.71)	0
Sugar (g)	102.38 + 52.52	100.65 (70.53 - 130.18)	106.19 + 48.83	102.72 (77.55 - 130.81)	0
Carbohydrate (g)	218.34 + 61.03	222.12 (188.59 - 254.29)	224.84 + 57.74	225.97 (193.83 - 257.57)	0
Fibre (g)	45.51 + 6.50	44.65 (40.88 - 48.99)	43.91 + 6.32	43.00 (39.50 - 47.19)	0
Iron (mg)	10.36 + 4.18	9.84 (7.82 - 12.24)	11.02 + 4.44	10.32 (8.33 - 13.00)	0
Thiamin (mg)	1.59 + 1.08	1.35 (1.00 - 1.89)	1.54 + 1.12	1.26 (0.94 - 1.81)	0
Saturated fat (g)	29.89 + 11.22	29.21 (23.4 - 35.39)	27.13 + 10.75	26.70 (20.89 - 32.77)	0
MUFA (g) <sup>a</sup>	28.17 + 10.59	27.40 (22.38 - 33.02)	27.45 + 10.60	26.69 (21.91 - 31.84)	0
PUFA (g) <sup>aa</sup>	10.18 + 5.54	9.48 (7.11 - 12.36)	11.23 + 6.03	10.18 (7.76 - 13.33)	0
n-3 PUFA (mg) <sup>aaa</sup>	191.19 + 378.53	109.65 (60.67 - 179.35)	276.00 + 769.83	118.31 (64.43 - 221.57)	0
Cholesterol (mg)	317.58 + 232.42	248.34 (178.87 - 384.78)	270.95 + 194.27	231.02 (164.80 - 320.31)	0
Riboflavin (mg)	1.82 + 1.05	1.65 (1.16 - 2.27)	1.93 + 1.04	1.75 (1.28 - 2.35)	0
Niacin (mg)	39.01 + 13.99	36.89 (30.58 - 45.02)	39.91 + 15.26	37.60 (30.42 - 47.01)	0
Vitamin B6 (mg)	1.35 + 1.29	1.15 (0.88 - 1.51)	1.44 + 1.20	1.27 (0.99 - 1.65)	0
Vitamin B12 (ug)	4.43 + 4.04	3.94 (2.77 - 5.39)	4.38 + 3.57	3.91 (2.73 - 5.41)	0
Phosphorous (mg)	1422.44 + 382.30	1392.54 (1203.13 - 1599.74)	1422.13 + 425.44	1377.82 (1173.88 - 1625.20)	0.09
Magnesium (mg)	301.20 + 97.17	290.50 (239.54 - 348.83)	329.13 + 107.16	312.39 (259.22 - 378.53)	0
Zinc (mg)	10.36 + 4.16	9.73 (7.94 - 11.92)	10.68 + 5.15	9.60 (7.87 - 12.24)	0
Potassium (mg)	2614.59 + 846.01	2559.59 (2559.59 - 3662.94)	2886.59 + 903.11	2795.91 (2299.70 - 3391.70)	0
Iodine (ug)	180.81 + 77.70	172.31 (131.80 - 218.44)	167.34 + 73.32	160.30 (122.02 - 204.79)	0
Selenium (ug)	86.29 + 50.26	77.26 (62.36 - 98.47)	85.64 + 54.11	75.50 (59.84 - 99.32)	0

	Consumer (n = 3893)		Non-consumer (n =8260)		p-value*
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	
Sodium (mg)	2843.87 + 1055.26	2701.85 (2162.52 - 3378.80)	2197.66 + 1011.26	2103.75 (1615.23 - 2665.12)	0

◻Monounsaturated fat ◻◻Polyunsaturated fat ◻◻◻Long chain omega 3 polyunsaturated fatty acids  
 \*independent samples t-test to compare nutrient intakes between pork consumers and non-consumers

Total, fresh and processed pork contributed substantially to the intakes of a number of nutrients in consumers (Table 7). For total pork consumers, pork contributed to intakes of LC n-3 PUFA (median: 9.81% of total intake), thiamin (9.28%), selenium (9.23%), protein (9.21%), niacin (8.59%), zinc (7.32%) and phosphorous (7.28%). In fresh pork consumers, fresh pork contributed substantially to intakes of thiamin (37.81%), niacin (33.70%), protein (29.81%), selenium (22.22%), LC n-3 PUFA (21.51%), zinc (20.52%), vitamin B6 (18.56%), and phosphorous (16.89%). For processed pork consumers, processed pork contributed to intakes of selenium (7.94%), LC n-3 PUFA (7.74%), protein (7.26%), niacin (6.69%) and phosphorous (6.14%). Pork also contributed to sodium intakes in total pork consumers (14.08%) and processed pork consumers (15.96%), saturated fat in total pork consumers (6.26%), fresh pork consumers (9.92%) and processed pork consumers (5.33%), and cholesterol in total pork consumers (10.53%), fresh pork consumers (24.62%) and processed pork consumers (8.98%).

**Table 7 - Mean + standard deviation and median (interquartile range) percentage contribution (%) of total, fresh and processed pork to total nutrient intake of consumers**

	Pork consumers (n = 4251)		Fresh pork consumers (n = 738)		Processed pork consumers (n=3697)	
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)
Energy (kJ)	6.69 + 7.58	4.25 (1.60 - 8.47)	11.76 + 10.09	9.30 (4.86 - 15.59)	5.20 + 5.68	3.41 (1.39 - 6.71)
Protein (g)	14.76 + 14.87	9.21 (4.50 - 18.73)	30.62 + 18.82	29.81 (14.26-43.55)	10.42 + 9.39	7.26 (4.08 - 13.59)
Total fat (g)	11.20 + 13.36	6.57 (1.38 - 15.36)	15.91 + 16.83	9.87 (4.03 - 21.18)	9.53 + 11.38	5.62 (1.15 - 13.70)
Sugar (g)	0.38 + 0.84	0.17 (0.06 - 0.39)	0.00 + 0.02	0.00 (0.00 - 0.00)	0.44 + 0.89	0.22 (0.10 - 0.45)
Carbohydrate (g)	0.39 + 1.04	0.16 (0.05 - 0.35)	0.00 + 0.01	0.00 (0.00 - 0.00)	0.46 + 1.11	0.19 (0.10 - 0.41)
Fibre (g)	2.03 + 3.71	0.84 (0.00 - 2.35)	0.00 + 0.08	0.00 (0.00 - 0.00)	2.37 + 3.91	1.21 (0.07 - 2.84)
Iron (mg)	6.45 + 7.77	3.69 (1.52 - 8.01)	8.63 + 7.40	6.58 (3.32 - 11.93)	5.60 + 7.28	2.97 (1.36 - 6.58)
Thiamin (mg)	16.98 + 18.31	9.28 (4.22 - 23.87)	38.71 + 21.74	37.81 (21.15-56.07)	11.21 + 11.65	7.22 (3.50 - 14.86)
Saturated fat (g)	11.25 + 14.13	6.26 (1.22 - 15.00)	16.68 + 18.39	9.92 (3.79 - 22.22)	9.42 + 11.81	5.33 (1.01 - 13.04)
MUFA (g) <sup>a</sup>	13.58 + 15.38	8.21 (1.74 - 19.86)	17.60 + 18.14	11.15 (4.12 - 24.07)	11.93 + 13.68	7.24 (1.46 - 17.39)
PUFA (g) <sup>aa</sup>	8.82 + 11.68	4.47 (1.14 - 11.36)	14.96 + 15.82	9.40 (3.68 - 21.13)	6.96 + 9.13	3.57 (0.98 - 9.31)
n-3 PUFA (mg) <sup>aaa</sup>	20.25 + 23.93	9.81 (2.59 - 28.95)	30.28 + 28.31	21.51 (6.27 - 47.35)	16.90 + 20.82	7.74 (2.37 - 23.82)
Cholesterol (mg)	17.35 + 18.26	10.53 (5.27 - 22.07)	30.25 + 23.36	24.62 (10.91-47.12)	13.53 + 13.93	8.98 (4.78 - 16.95)
Riboflavin (mg)	6.12 + 8.42	3.07 (1.08 - 7.56)	11.90 + 11.92	9.09 (3.77 - 16.67)	4.50 + 6.08	2.44 (0.99 - 5.48)
Niacin (mg)	14.74 + 15.78	8.59 (4.11 - 18.78)	33.84 + 20.04	33.70 (16.30-48.63)	9.68 + 8.87	6.69 (3.62 - 12.90)
Vitamin B6 (mg)	9.60 + 13.03	3.90 (1.47 - 12.07)	22.25 + 16.55	18.56 (8.78 - 32.53)	6.26 + 9.08	2.78 (1.20 - 7.27)
Vitamin B12 (ug)	11.06 + 13.21	6.25 (2.94 - 13.64)	17.32 + 16.82	12.07 (5.31 - 24.09)	9.06 + 10.82	5.49 (2.74 - 10.89)
Phosphorous (mg)	11.27 + 10.82	7.28 (3.88 - 15.10)	18.90 + 13.44	16.89 (8.30 - 28.11)	8.95 + 8.25	6.14 (3.61 - 11.53)
Magnesium (mg)	4.72 + 5.43	2.74 (1.38 - 5.81)	9.33 + 7.41	7.74 (3.92 - 12.75)	3.43 + 3.63	2.29 (1.27 - 4.21)
Zinc (mg)	12.20 + 13.13	7.32 (2.88 - 16.40)	22.80 + 15.30	20.52 (10.79-32.85)	9.17 + 10.17	5.57 (2.47 - 11.80)
Potassium (mg)	7.55 + 8.28	4.57 (2.23 - 9.80)	14.87 + 11.24	12.75 (6.35 - 20.30)	5.50 + 5.61	3.63 (2.01 - 6.98)
Iodine (ug)	1.17 + 1.67	0.73 (0.30 - 1.44)	0.69 + 0.72	0.49 (0.24 - 0.89)	1.21 + 1.75	0.74 (0.29 - 1.48)

	Pork consumers (n = 4251)		Fresh pork consumers (n = 738)		Processed pork consumers (n=3697)	
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)
Selenium (ug)	14.61 + 14.66	9.23 (4.93 - 18.54)	25.65 + 20.49	22.22 (6.57 - 41.61)	11.35 + 10.31	7.94 (4.67 - 14.44)

°Monounsaturated fat °°Polyunsaturated fat °°°Long chain omega 3 polyunsaturated fatty acids

Total, fresh and processed pork contributed substantially to the intakes of a number of nutrients in consumers, in comparison to the Estimated Average Requirement (EAR) or Adequate Intake (AI) (Table 8). For total pork consumers, pork contributed substantially to intakes of niacin in comparison to the nutrient reference value (median: 29.01% of EAR), protein (19.30%), phosphorous (15.90%), selenium (13.87%), thiamin (13.64%), and vitamin B12 (12.67%). In fresh pork consumers, fresh pork contributed substantially to intakes of niacin (127% of EAR), thiamin (74%), protein (63.63%), selenium (38.30%), phosphorous (35.99%), zinc (23.69%), vitamin B6 (22.40%), LC n-3 PUFA (19.67%), vitamin B12 (17.87%), riboflavin (14.44%) and potassium (11.59%). For processed pork consumers, processed pork contributed to intakes of niacin (22.18%), protein (16.35%), phosphorous (13.20%), selenium (12.40%), vitamin B12 (11.12%) and thiamin (10.24%).

**Table 8 - Mean ± standard deviation and median (interquartile range) percentage contribution (%) of total, fresh and processed pork to Estimated Average Requirements (EAR) or Adequate Intakes (AI) of consumers**

	Pork consumers (n = 4251)		Fresh pork consumers (n = 738)		Processed pork consumers (n=3697)	
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)
Protein (g)	34.91 + 43.52	19.30 (8.54 - 42.10)	75.07 + 63.05	63.63 (32.67 - 95.79)	24.06 + 26.50	16.35 (7.81 - 30.65)
Fibre (g)	1.45 + 2.40	0.77 (0.00 - 1.72)	0.00 + 0.08	0.00 (0.00 - 0.00)	1.70 + 2.51	1.03 (0.05 - 2.03)
Iron (mg)	10.31 + 13.55	5.50 (2.27 - 12.66)	12.77 + 11.51	9.47 (5.38 - 16.67)	9.19 + 13.22	4.41 (2.00 - 10.65)
Thiamin (mg)	32.14 + 49.35	13.64 (7.00 - 36.00)	89.90 + 79.03	74.00 (33.52-124.00)	17.53 + 19.56	10.24 (7.00 - 21.43)
n-3 PUFA (mg)°°°	20.28 + 30.10	10.06 (2.37 - 26.71)	25.39 + 25.34	19.67 (6.65 - 33.56)	18.02 + 29.54	8.15 (2.07 - 22.13)
Riboflavin (mg)	9.65 + 12.79	5.45 (1.82 - 12.22)	18.83 + 19.19	14.44 (5.75 - 24.55)	7.08 + 8.53	4.44 (1.82 - 9.09)
Niacin (mg)	58.23 + 78.64	29.01 (13.56-68.00)	149.40+120.46	127.00(65.43-200.38)	34.76 + 34.26	22.18 (11.09-46.92)
Vitamin B6 (mg)	12.30 + 21.18	3.85 (1.54 - 13.64)	30.63 + 31.51	22.40 (10.08 - 39.04)	7.55 + 13.76	2.86 (1.00 - 7.27)
Vitamin B12 (ug)	20.56 + 26.94	12.67 (6.00 - 24.93)	26.14 + 27.01	17.87 (10.67 - 32.50)	18.17 + 25.12	11.12 (5.00 - 22.00)
Phosphorous (mg)	26.53 + 28.58	15.90 (7.62 - 34.76)	44.67 + 37.98	35.99 (18.66 - 61.90)	21.03 + 21.30	13.20 (7.62 - 26.90)
Magnesium (mg)	5.13 + 6.15	3.09 (1.45 - 6.24)	10.00 + 8.70	8.15 (4.06 - 13.17)	3.76 + 4.19	2.49 (1.41 - 4.57)

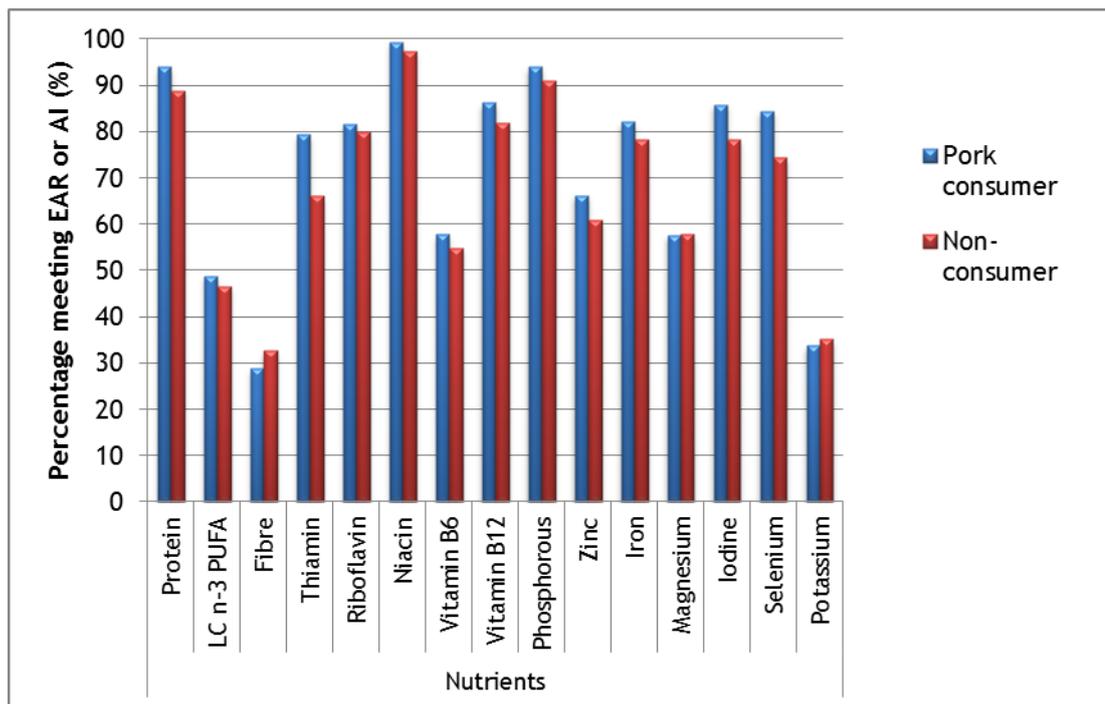
	Pork consumers (n = 4251)		Fresh pork consumers (n = 738)		Processed pork consumers (n=3697)	
	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)	Mean + SD	Median (IQR)
Zinc (mg)	16.45 + 21.81	8.86 (3.40 - 20.67)	28.82 + 24.35	23.69 (12.99 - 37.31)	12.79 + 18.77	6.92 (2.92 - 15.50)
Potassium (mg)	6.31 + 7.67	3.45 (1.90 - 7.94)	13.84 + 11.72	11.59 (5.83 - 17.89)	4.29 + 4.15	2.83 (1.66 - 5.58)
Iodine (ug)	1.93 + 2.28	1.44 (0.52 - 2.31)	0.86 + 0.71	0.66 (0.38 - 1.12)	2.06 + 2.39	1.50 (0.53 - 2.61)
Selenium (ug)	25.71 + 32.12	13.87 (6.74 - 29.45)	47.32 + 44.71	38.30 (9.07 - 67.20)	19.49 + 23.20	12.40 (6.74 - 22.55)

====Long chain omega 3 polyunsaturated fatty acids

The proportion of pork consumers and non-consumers meeting the EAR or AI for key nutrients is shown in Figure 24. When compared to individuals who did not eat pork, a significantly higher proportion of pork consumers met the requirements for protein ( $\chi^2=153178.66(1)$ ,  $p=0.00$ ), long chain omega-3 polyunsaturated fatty acids ( $\chi^2=11078.42(1)$ ,  $p=0.00$ ), thiamin ( $\chi^2=434885.74(1)$ ,  $p=0.00$ ), riboflavin ( $\chi^2=10548.14(1)$ ,  $p=0.00$ ), niacin ( $\chi^2=124493.65(1)$ ,  $p=0.00$ ), vitamin B6 ( $\chi^2=19928.87(1)$ ,  $p=0.00$ ), vitamin B12 ( $\chi^2=75405.41(1)$ ,  $p=0.00$ ), phosphorous ( $\chi^2=61636.37(1)$ ,  $p=0.00$ ), zinc ( $\chi^2=62549.03(1)$ ,  $p=0.00$ ), iron ( $\chi^2=49284.68(1)$ ,  $p=0.00$ ), iodine ( $\chi^2=183070.19(1)$ ,  $p=0.00$ ) and selenium ( $\chi^2=299629.19(1)$ ,  $p=0.00$ ).

Pork consumers were more likely to meet their requirements for a number of key nutrients, including iron, than non-consumers. Despite being more likely to meet their individual dietary requirements for iron, median iron intakes were actually lower in pork consumers than non-consumers. This discrepancy likely reflects the fact dietary requirements differ between individuals based on gender and age. Despite this discrepancy, individuals consuming pork as part of their total diet are no less likely to meet their dietary iron requirements when compared to non-pork consumers.

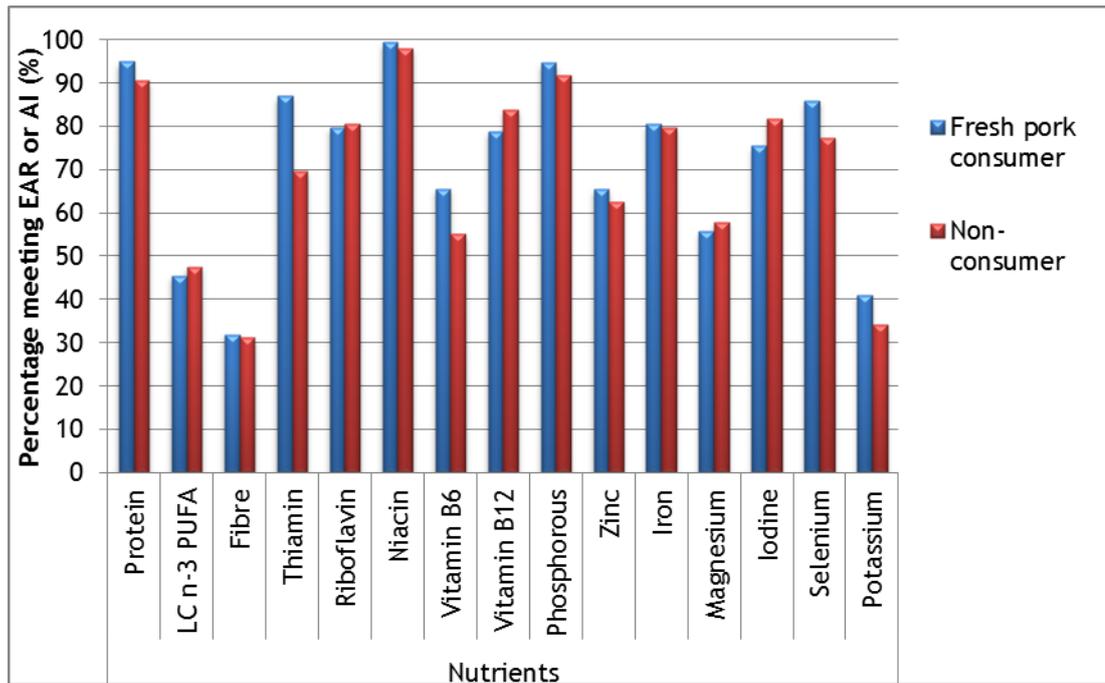
In comparison, a significantly higher proportion of non-consumers met the requirements for fibre ( $\chi^2=35973.48(1)$ ,  $p=0.00$ ), magnesium ( $\chi^2=40.46(1)$ ,  $p=0.00$ ) and potassium ( $\chi^2=3933.97(1)$ ,  $p=0.00$ ) than pork consumers, although the differences were small for magnesium and potassium.



**Figure 24 - Percentage total pork consumers and non-consumers meeting Estimated Average Requirements (EAR) or Adequate Intakes (AI) for key nutrients on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

The proportion of fresh pork consumers and non-consumers meeting the EAR or AI for key nutrients is shown in Figure 25. Compared to non-consumers, a significantly higher proportion of fresh pork consumers met the requirements for protein ( $\chi^2 = 36141.96(1)$ ,  $p=0.00$ ), fibre ( $\chi^2 = 476.15(1)$ ,  $p=0.00$ ), thiamin ( $\chi^2 = 221651(1)$ ,  $p=0.00$ ), niacin ( $\chi^2 = 15940.38(1)$ ,  $p=0.00$ ), vitamin B6 ( $\chi^2 = 68796.56(1)$ ,  $p=0.00$ ), phosphorous ( $\chi^2 = 16268.33(1)$ ,  $p=0.00$ ), zinc ( $\chi^2 = 5359.49(1)$ ,  $p=0.00$ ), iron ( $\chi^2 = 557.56(1)$ ,  $p=0.00$ ), and selenium ( $\chi^2 = 66407.87(1)$ ,  $p=0.00$ ) and potassium ( $\chi^2 = 32395.42(1)$ ,  $p=0.00$ ).

In comparison, a significantly higher proportion of non-consumers met the requirements for long chain omega-3 polyunsaturated fatty acids ( $\chi^2 = 2759(1)$ ,  $p=0.00$ ), riboflavin ( $\chi^2 = 859.46(1)$ ,  $p=0.00$ ), vitamin B12 ( $\chi^2 = 29028.57(1)$ ,  $p=0.00$ ), magnesium ( $\chi^2 = 2793.63(1)$ ,  $p=0.00$ ), iodine ( $\chi^2 = 37574.41(1)$ ,  $p=0.00$ ), compared to pork consumers.



**Figure 25 - Percentage of fresh pork consumers and non-consumers meeting Estimated Average Requirements (EAR) or Adequate Intakes (AI) for key nutrients on day one of the 2011-2013 National Nutrition and Physical Activity Survey**

The proportion of processed pork consumers and non-consumers meeting the EAR or AI for key nutrients is shown in Figure 26. Compared to non-consumers, a significantly higher proportion of processed pork consumers met the requirements for protein ( $\chi^2= 134225.93(1)$ ,  $p=0.00$ ), long chain omega-3 polyunsaturated fatty acids ( $\chi^2= 21168.14(1)$ ,  $p=0.00$ ), thiamin ( $\chi^2= 268591.74(1)$ ,  $p=0.00$ ), riboflavin ( $\chi^2= 19820.80(1)$ ,  $p=0.00$ ), niacin ( $\chi^2= 105972.35(1)$ ,  $p=0.00$ ), vitamin B6 ( $\chi^2= 5297.88(1)$ ,  $p=0.00$ ), vitamin B12 ( $\chi^2= 173861.17(1)$ ,  $p=0.00$ ), phosphorous ( $\chi^2= 58069.50(1)$ ,  $p=0.00$ ), zinc ( $\chi^2= 74895.77(1)$ ,  $p=0.00$ ), iron ( $\chi^2= 64249.45(1)$ ,  $p=0.00$ ), magnesium ( $\chi^2= 909.58(1)$ ,  $p=0.00$ ), iodine ( $\chi^2= 313362.52(1)$ ,  $p=0.00$ ) and selenium ( $\chi^2= 239317.95(1)$ ,  $p=0.00$ ).

In comparison, a significantly higher proportion of non-consumers met the requirements for fibre ( $\chi^2= 38610.62(1)$ ,  $p=0.00$ ) and potassium ( $\chi^2= 21875.35(1)$ ,  $p=0.00$ ), compared to processed pork consumers.

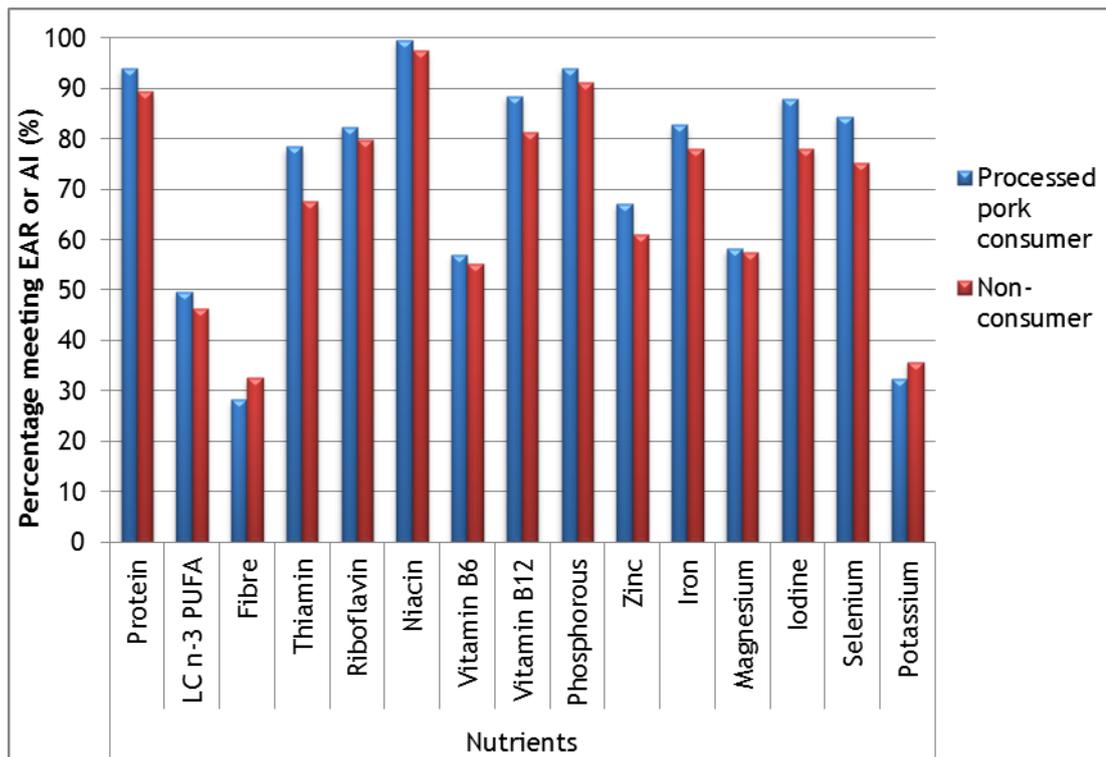


Figure 26 - Percentage of processed pork consumers and non-consumers meeting Estimated Average Requirements (EAR) or Adequate Intakes (AI) for key nutrients on day one of the 2011-2013 National Nutrition and Physical Activity Survey

*Exploration of potential health benefits associated with pork consumption*

**BMI**

Chi-squared analyses suggested that there were significant differences in the proportion of individuals presenting as being underweight, of normal weight, overweight and obese between pork consumers and those not consuming any pork (all  $p = 0.00$ ) (Figure 27). It should be noted, however that the absolute difference in the proportion of individuals within each BMI category was minimal between pork consumers and non-consumers, suggesting that the significant result observed may be due to the large sample size of the weighted data rather than a true difference across BMI categories.

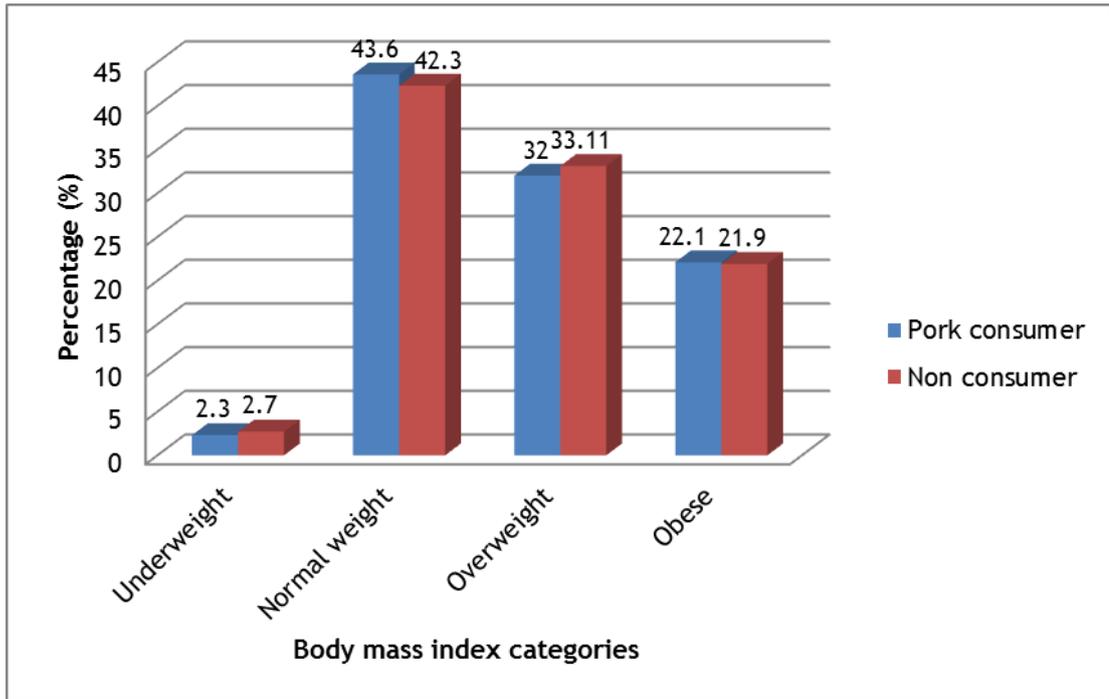


Figure 27 - Body mass index of pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey

Similar significant differences across all BMI categories were observed when analyses were completed between both processed pork consumers and non-consumers and fresh pork consumers and non-consumers (all  $P=0.00$ ). However, again absolute differences in the proportion of individuals within most of the BMI categories were minimal (Figures 28 and 29), suggesting that the significant result observed may be due to the large sample size of the weighted data rather than a true difference across BMI categories. The only exception to this was perhaps for fresh pork consumers, of which a clinically meaningful greater proportion of individuals consuming fresh pork were classified as obese when compared to non-consumers. In contrast, more non-consumers were classified as overweight in comparison to fresh pork consumers, suggesting that fresh pork consumers may be more likely to be classified as obese in comparison to non-consumers. In comparison, non-consumers were more likely to be classified as overweight. However, the lack of a clear trend across BMI categories limits the conclusions which can be drawn in this area.

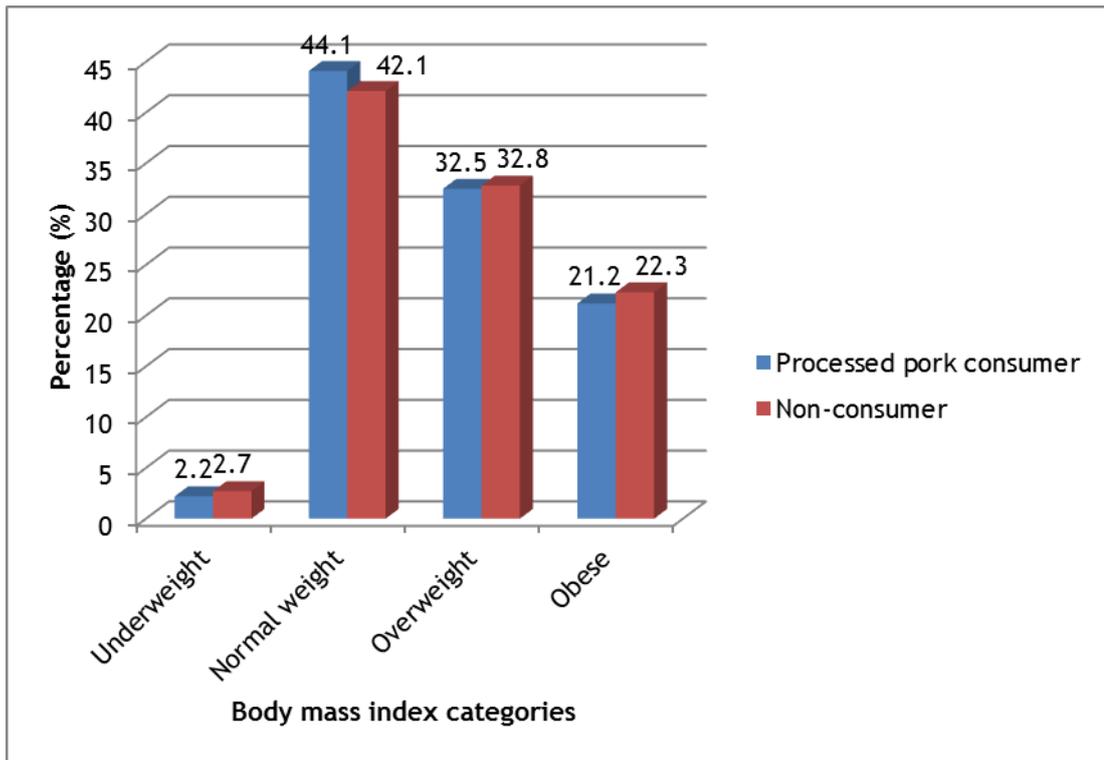


Figure 28 - Body mass index of processed pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey

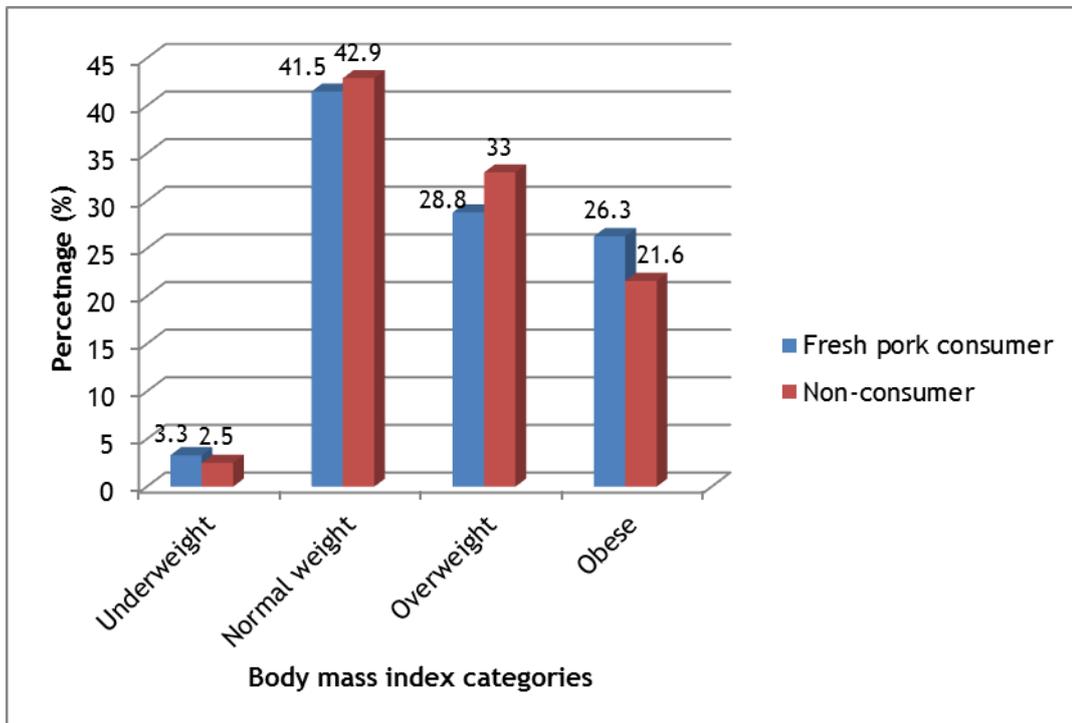
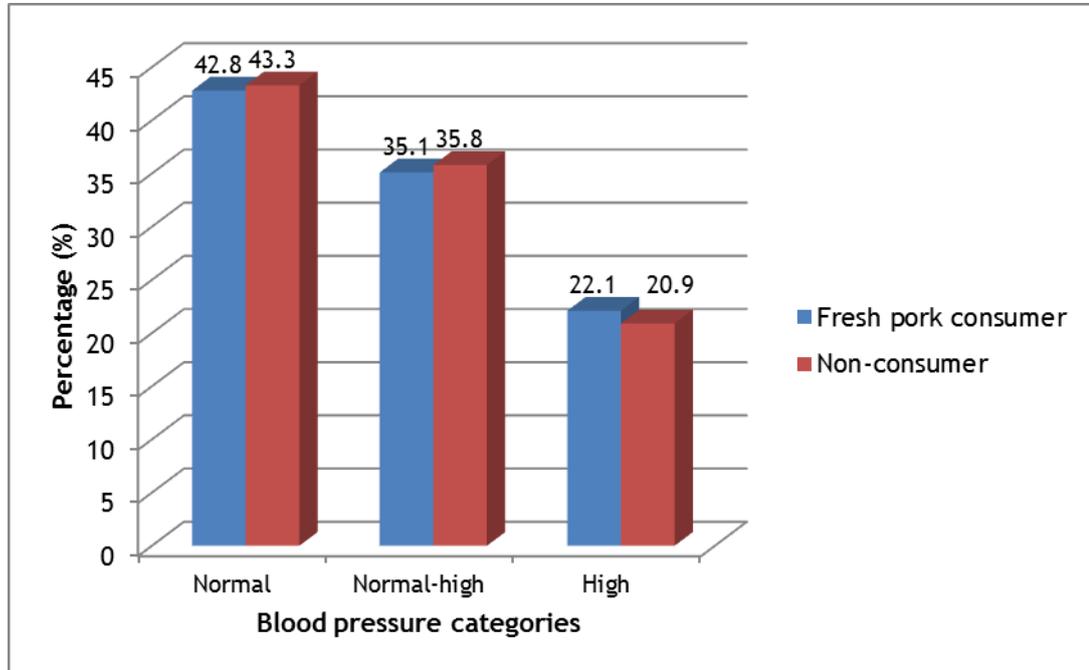


Figure 29 - Body mass index of fresh pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey

### Blood pressure

Similar to results observed for BMI, chi-squared analyses suggested that there were significant differences in the proportion of participants with normal, normal-

high and high blood pressure between pork consumers and those not consuming any pork (all  $P=0.00$ ). Again, despite these results, the absolute difference in the proportion of individuals within each blood pressure category was minimal between pork consumers and non-consumers, suggesting that the significant result observed may be due to the large sample size of the weighted data rather than a true difference across categories of blood pressure status (Figure 30).



**Figure 30. Blood pressure categories of pork consumers and non-consumers participating in day one of the 2011-2013 Australian Health Survey**

Significant differences in the proportion of participants with normal, normal-high and high blood pressure between fresh pork consumers, processed pork consumers and non-consumers were noted (all  $P=0.00$ ). The only exception to this was the lack of a significant difference observed between processed pork consumers and non-consumers categorized as having normal and normal-high blood pressure ( $\chi^2=2.735(1)$ ,  $P=0.098$ ).

Again, despite these results, the absolute difference in the proportion of individuals within each blood pressure category suggesting that results obtained may be due to the large sample size of the weighted data rather than a true difference across categories of blood pressure status (Figures 31 and 32).

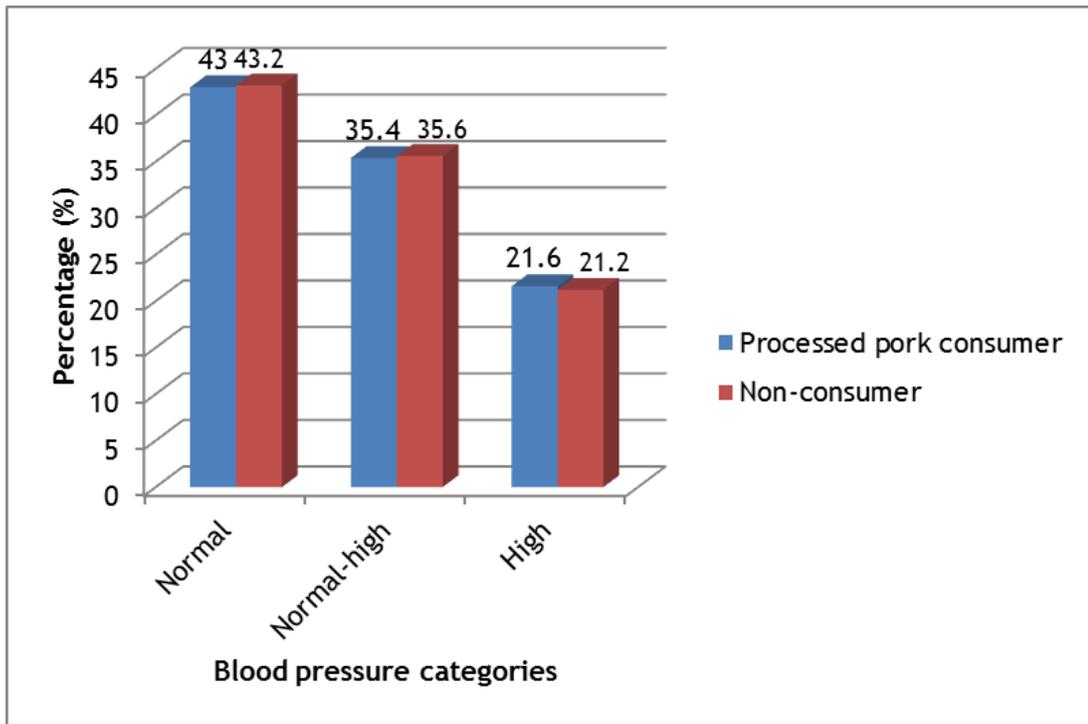


Figure 31 - Blood pressure categories of processed pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey

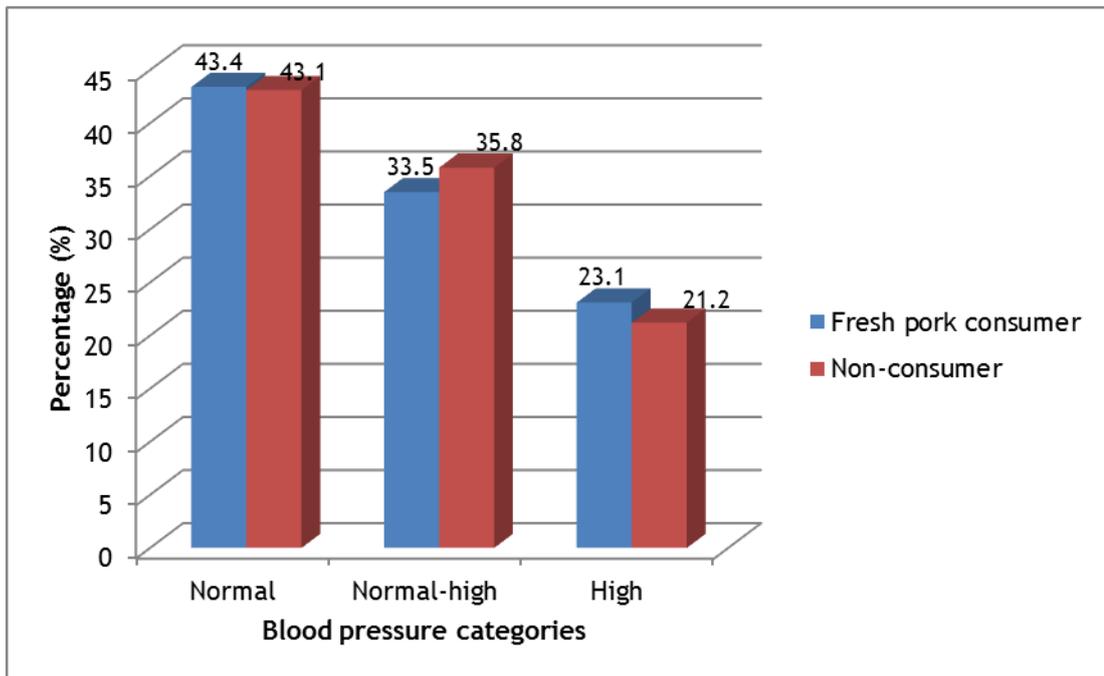


Figure 32 - Blood pressure categories of fresh pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey

### Waist Circumference

A statistically significant difference between the waist circumference of pork consumers and non-consumers was identified ( $P=0.00$ ), however the absolute difference between the mean values was extremely small, with a mean waist

circumference for pork consumers of 87.47±17.8cm compared to 86.8±17.8cm for non-consumers suggesting that again results may have been skewed by the large sample size. Similarly, a significant difference between the waist circumference of fresh pork consumers and non-consumers was identified (P=0.00), however the lack of absolute difference between mean values (Table 9) suggest that this difference is unlikely to be of clinical relevance and more likely relates to the large sample size.

There was no significant difference between the waist circumference of processed pork consumers and non-consumers (P=0.276).

### Body weight

There was a significant difference between the body weight of pork consumers and non-consumers (P=0.00), with pork consumers having a slightly higher mean body weight in comparison to non-consumers (Table 9). However the small absolute difference between mean values suggests that this is unlikely to be of clinical significance.

A significantly greater body weight was observed for fresh pork consumers in comparison to non-consumers (P=0.00). In contrast, no significant difference in body weight was identified between consumers of processed pork and non-consumers (P=0.276). It should be noted however, that this analysis was not controlled for total energy intake (as outlined in the methods section) which may limit the reliability of this result.

**Table 9. Anthropometric characteristics of pork consumers and non-consumers participating in day one of the 2011-2013 National Nutrition and Physical Activity Survey (n=4501)**

Pork consumption type	Body weight (kg) (Mean±SD)	Body weight (kg) [Median(IQR)]	Waist circumference (cm) (Mean±SD)	Waist circumference (cm) [Median (IQR)]
Pork consumer	71.4±24.03	72.7 (57.7-86.5)	87.47±17.80	87.5(75.4-100.0)
Non-consumer	69.74±23.87	70.6 (57.1-85.0)	86.78±17.799	87.0 (75.0-99.0)
Fresh pork consumer	73.81±23.09	72.0 (59.2-87.4)	89.58±17.11	88.8 (78.0-101.0)
Fresh pork non-consumer	70.07±23.99	71.4 (57.1-85.4)	86.82±17.85	87.0 (75.0-99.0)
Processed pork consumer	70.9±24.33	72.9 (57.2-86.5)	87.02±18.0	87.0 (75.0-100.0)
Processed pork non-consumer	70.088±23.76	70.6 (57.5-85.1)	87.05±17.7	87.2 (75.0-99.0)

## 4. Application of Research

### *Opportunities uncovered by the research*

Several opportunities have been identified as a result of this research which should directly benefit the pork industry. The identification of up-to date pork consumption data including sub-analyses of major pork categories (processed and fresh pork) across a range of demographic groups will be invaluable in terms of facilitating targeted marketing approaches to increase intakes of pork in the

Australian diet. Opportunities to the pork industry that were identified were as follows:

- There is significant scope to increase the intake of fresh pork across the Australian population, with intakes of processed pork far exceeding fresh pork varieties across a range of demographic backgrounds
- In particular, key target groups for promoting fresh pork consumption could include females, individuals aged more than 51 years old, individuals living outside of the major Australian cities, and those born in Australia or a major English speaking country.
- This report builds on previously identified work that identifies the important contribution of pork to key nutrients within the Australian diet and will be invaluable for marketing the unique nutritional benefits of pork to Australian consumers

### ***Impact of the research***

This research will contribute to the evidence base surrounding the important position of pork as a core food in the diet of Australian adults and children. The quantification of intakes of processed, fresh and more recently consumed pork varieties (such as pork belly) in addition to demographic analyses of consumers and non-consumers may provide important insights for the strategic marketing of pork varieties to the Australian population. This analysis of the contribution of pork to key nutrient requirements will also be invaluable in terms of providing evidence to substantiate marketing efforts seeking to expose the unique nutritional benefits of consuming pork as part of a balanced diet.

## **5. Conclusion**

Following a comprehensive analysis of pork consumption within the Australian National Nutrition and Physical Activity Survey, several key findings were made:

- 1 Just over a third (37.4%) of Australians reported eating any type of pork on the survey day evaluated, with 7.70% consuming fresh pork and 32.0% consuming processed pork. Of those consuming pork, the vast majority consumed processed pork rather than fresh pork.
- 2 Ham was the pork variety consumed in the greatest amount, followed by bacon. Within the fresh pork category, pork loin was consumed in the greatest amount.
- 3 Mean intake of unprocessed pork was lower than other unprocessed meats, with chicken consumed in the greatest quantity, followed by beef and lamb/mutton.
- 4 Males consumed pork in greater quantities than females
- 5 A significantly lower proportion of individuals who consumed total or processed pork were born in Australia than other countries. In comparison, a higher proportion of fresh pork consumers were born in non-English speaking country than in Australia or another major English speaking country such as the United States, United Kingdom, Canada or New Zealand. A significantly higher proportion of fresh pork consumers also lived in a major Australian city, compared to an inner regional or other area.
- 6 The consumption of pork was beneficial to the nutrient intake of consumers, with more pork consumers meeting their dietary requirements for protein, long chain omega-3 polyunsaturated fatty acids, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, phosphorous, zinc, iron, iodine and selenium than non-consumers.

- 7 Pork consumers consumed significantly higher amounts of protein, fibre, thiamin, monounsaturated fat, iodine and selenium than non-consumers. However it should be noted that intakes of energy, total and saturated fat, cholesterol and sodium were also higher amongst pork consumers.
- 8 Pork consumers were more likely to meet their requirements for a number of key nutrients, including iron, than non-consumers. Despite being more likely to meet their individual dietary requirements for iron, median iron intakes were actually lower in pork consumers than non-consumers. This discrepancy likely reflects the fact dietary requirements differ between individuals based on gender and age. Despite this discrepancy, the take home message in relation to iron seems to be that individuals consuming pork as part of their total diet are no less likely to meet their dietary iron requirements when compared to non-pork consumers. This finding may be pertinent in the context of highlighting the role of pork in a total diet which can meet iron requirements.
- 9 Despite the large sample size from the use of weighted survey data suggesting significant differences between pork consumers and non-consumers in terms of body weight, waist circumference and blood pressure, the lack of an absolute difference in these measures between intake groups suggests that these differences are unlikely to be of clinical relevance.

Overall, results from this analysis suggest that pork is a relatively widely consumed food that is favourably contributing to the intake of a number of key nutrients within the Australian diet, with no clinically relevant adverse health effects. Increasing intakes of fresh pork in comparison to processed pork remains a key industry priority.

## 6. Limitations/Risks

This research should be considered in the context of the following limitations when evaluating the results obtained:

- All results were based on a secondary analysis of a large national nutrition survey. Whilst the survey was designed and the data weighted to ensure that results obtained were nationally representative of Australian nutrition intakes, some inherent limitations in the survey design may influence the reliability of results obtained. In particular, the use of a 24 hour dietary recall to collect dietary data may not reflect habitual dietary intakes. In addition, the large proportion of individuals that did not complete two days of dietary recalls (36.4% of the survey population), coupled with a lack of a food frequency questionnaire to estimate the frequency of pork consumption, meant that it was more accurate to limit analyses to day one of the survey rather than an average of the two days - potentially introducing a further source of error.
- It was not possible to determine the percentage of pork contained within the food category 'processed meats including pork' due to a lack of reliable recipe data from Food Standards Australia and New Zealand. It is therefore possible that actual pork consumption in this category may have been slightly over-estimated.
- The use of weighted data for the survey analyses allowed the data to be representative of the wider Australian population. However, it resulted in an extremely large sample size for statistical purposes, thus whilst statistically significant differences in both key nutrient intakes and health factors were identified between pork consumers and non-consumers, the

clinical relevance of this difference should be considered. The use of this weighted data also meant that it was not possible to use ANCOVA to determine whether associations between health factors and pork consumption were present, thus covariates that may influence these associations such as physical activity and total energy intake were unable to be taken into consideration.

- Finally, the cross-sectional nature of the data utilized in these analyses may limit its reliability when seeking to explore associations between chronic health conditions such as obesity and hypertension. Long term prospective cohort studies or randomized controlled trials exploring intakes of pork and associations with these chronic health conditions would be preferable for this purpose.

## 7. Recommendations

As a result of the outcomes in this study the following recommendations have been made:

- Pork may be promoted as an important core food that contributes key nutrients to the diet of Australian adults and children
- Given the consistent preference for processed pork in contrast to fresh pork across both adults and children, there is a need for marketing efforts to focus on fresh pork promotion strategies particularly targeting females
- Given the limitations of using cross-sectional data to explore the health effects of pork consumption, it may be prudent to invest in either randomized controlled trials or prospective cohort studies to obtain further evidence relating to the effect of pork consumption on chronic conditions such as obesity and hypertension
- Efforts to translate and communicate the unique nutritional contribution of pork to the Australian diet should remain key industry priorities to promote pork consumption

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## 9. Appendices

### ***Appendix 1 - Gross weekly equivalised cash income of household (\$)***

First decile - Less than \$333  
Second decile - \$333-\$398  
Third decile - \$399-\$502  
Fourth decile - \$503-\$638  
Fifth decile - \$639-\$795  
Sixth decile - \$796-\$958  
Seventh decile - \$959- \$1,151  
Eighth decile - \$1,152- \$1,437  
Ninth decile - \$1,438- \$1,917  
Tenth decile - \$1,918 or more

### ***Appendix 2 - List of mixed dishes excluded from calculations of the contribution of pork to total intakes and nutrient reference value recommendations (due to absence of retention factors)***

- Stir-fry, commercial, rice noodles, added prawn, pork, egg & vegetable (mee grob) (13509078)
- Spring roll, meat &/or vegetable, purchased frozen, deep fried (13406013)
- Spring roll, meat &/or vegetable, purchased frozen, baked (13406012)
- Pizza, ham & pineapple, thick base, fast food chain (13501016)
- Dumpling or wonton, savoury, meat & vegetable filled, takeaway style, cooked (13406007)
- Stir-fry, commercial, rice noodles, added prawn, pork, egg & vegetable (mee grob) (13509078)
- Saveloy, battered, deep fried, oil not further defined (18801004)
- Pizza, supreme, thick base, fast food chain (13501032)
- Pizza, ham & pineapple, thin base, fast food chain (13501017)
- Dim sim, vegetable & meat filling, purchased frozen, microwaved or steamed (13405001)
- Dim sim, vegetable &/or meat filling, takeaway style, deep fried (13406004)
- Pizza, supreme, thin base, fast food chain (13501033)
- Stir-fry, commercial, pork, sweet & sour sauce (18708007)
- Spring roll, meat & vegetable filling, takeaway style, deep fried (13406017)
- Pizza, supreme, purchased frozen, baked (13502001)
- Quiche, Lorraine, commercial, baked (13404003)

**Appendix 3 - Median (interquartile range) intakes of pork (grams/day) consumed by Australians on day one of the 2011-2013 National Nutrition and Physical Activity Survey by category of pork, according to gender (unweighted data)**

Pork Category	Total sample (n = 12153)			Pork consumers (n = 4501)		
	Males (n=5702)	Females (n=6451)	p- value	Males (n=2325)	Females (n=2176)	p- value
All pork	0.00 (0.00 - 32.00)	0.00 (0.00-17.00)	0.00	42.00 (18.80 - 82.97)	30.00 (17.00 - 60.79)	0.00
All fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.01	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00
All processed pork	0.00 (0.00 - 18.80)	0.00 (0.00 - 14.80)	0.00	30.00 (17.00 - 57.00)	13.71 (20.31 - 43.74)	0.87
Mixed dishes containing fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.01	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.49
Mixed dishes containing processed pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00	0.00 (0.00 - 17.41)	0.00 (0.00 - 14.80)	0.11

Please note: as all data is non-parametric, only median (interquartile range) is shown. Unweighted data was used due to non-parametric data.

**Appendix 4 - Median (interquartile range) intakes of pork (grams) consumed by Australians on day one of the 2011-2013 National Nutrition and Physical Activity Survey by category of pork, according to age group (unweighted data)**

Pork Category	Total sample (n = 12153)								p-value
	2 - 3 years (n = 464)	4 - 8 years (n = 789)	9 - 13 years (n = 787)	14 - 18 years (n = 772)	19 - 30 years (n = 1592)	31 - 50 years (n = 3565)	51 - 70 years (n = 2906)	71 years and over (n = 1278)	
All pork	0.00 (0.00 - 9.23)	0.00 (0.00 - 18.80)	0.00 (0.00 - 24.38)	0.00 (0.00 - 34.00)	0.00 (0.00 - 25.00)	0.00 (0.00 - 25.94)	0.00 (0.00 - 17.00)	0.00 (0.00 - 17.00)	0.00
All fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00
All processed pork	0.00 (0.00 - 6.85)	0.00 (0.00 - 17.00)	0.00 (0.00 - 18.80)	0.00 (0.00 - 25.00)	0.00 (0.00 - 17.00)	0.00 (0.00 - 17.00)	0.00 (0.00 - 14.92)	0.00 (0.00 - 6.13)	0.00
Mixed dishes containing fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00
Mixed dishes containing processed pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00

Please note: as all data is non-parametric, only median (interquartile range) is shown. Unweighted data was used due to non-parametric data.

**Appendix 5 - Median (interquartile range) intakes of pork (grams) consumed by pork consumers on day one of the 2011-2013 National Nutrition and Physical Activity Survey by category of pork, according to age group (unweighted data)**

Total sample (n = 12153)

Pork Category	2 - 3 years (n = 464)	4 - 8 years (n = 789)	9 - 13 years (n = 787)	14 - 18 years (n = 772)	19 - 30 years (n = 1592)	31 - 50 years (n = 3565)	51 - 70 years (n = 2906)	71 years and over (n = 1278)	p- value
All pork	17.00 (12.00 - 31.58)	27.77 (17.00 - 50.78)	31.25 (17.00 - 57.00)	43.13 (20.15 - 80.60)	37.00 (17.60 - 70.54)	40.00 (17.96 - 81.25)	36.98 (17.00 - 78.99)	32.00 (17.00 - 65.46)	0.00
All fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00
All processed pork	17.00 (8.65 - 27.47)	23.60 (17.00 - 48.00)	25.00 (17.00 - 50.00)	31.43 (17.00 - 57.00)	25.00 (16.20 - 50.00)	28.00 (17.00 - 53.00)	23.00 (13.49 - 49.14)	17.00 (10.39 - 40.97)	0.00
Mixed dishes containing fresh pork	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.01
Mixed dishes containing processed pork	0.00 (0.00 - 5.48)	0.00 (0.00 - 17.00)	0.00 (0.00 - 18.50)	0.00 (0.00 - 26.92)	0.00 (0.00 - 22.80)	0.00 (0.00 - 17.69)	0.00 (0.00 - 7.61)	0.00 (0.00 - 3.04)	0.00

Please note: as all data is non-parametric, only median (interquartile range) is shown. Unweighted data was used due to non-parametric data.

**Appendix 6 - Proportion (%) of demographic characteristics of fresh pork consumers and non-consumers**

Characteristic	Consumers (n =852) %	Non-consumers (n =3649) %	Chi Squared analysis
<b>Sex:</b>			
- Male	53.80	49.40	$\chi^2 = 11839.09 (1)$ , p=0.00
- Female	46.20	50.60	
<b>Age group:</b>			
- 2-3 years	0.82	2.17	$\chi^2=101621.11 (7)$ , p=0.00
- 4-8 years	3.01	7.43	
- 9-13 years	5.37	8.91	
- 14-18 years	5.90	7.15	
- 19-30 years	20.35	18.17	
- 31-50 years	31.91	29.76	
- 51-70 years	24.95	19.32	
- 71 years and over	7.69	7.09	
<b>Remoteness:</b>			
- Major cities of Australia	77.46	70.09	$\chi^2 =40672.54(2)$ , p=0.00
- Inner regional Australia	15.64	20.06	
- Other	6.90	9.85	
<b>Country of birth</b>			
- Australia	65.04	74.41	$\chi^2 = 214497.18 (2)$ , p=0.00
- Main English speaking country	6.21	10.32	
- Other	28.75	15.27	
<b>SEIFA (Index of Relative Socio-Economic Disadvantage)</b>			
- Lowest 20%	18.93	17.83	$\chi^2=5702.80(4)$ , p=0.00
- Second quintile	21.18	19.69	
- Third quintile <sup>b</sup>	19.66	20.82	
- Fourth quintile	19.12	18.86	
- Highest 20% <sup>b</sup>	21.11	22.80	
<b>Equivalised income of household<sup>a</sup></b>			
- First decile	11.23	9.81	$\chi^2=26052.92 (9)$ , p= 0.00
- Second decile	5.74	6.84	
- Third decile	9.92	7.84	
- Fourth decile	10.64	9.96	
- Fifth decile	11.42	12.46	
- Sixth decile	10.25	10.28	
- Seventh decile	10.15	11.76	
- Eighth decile	12.52	10.10	
- Ninth decile	8.29	10.52	
- Tenth decile	9.85	10.43	

<sup>a</sup>Excluding n=470 (income not stated/not known)

<sup>b</sup> No significant difference found between consumers and non-consumers in post-hoc analysis ( $\chi^2 = 2.04(1)$ , p=0.15)

**Appendix 7. Proportion (%) of demographic characteristics of processed pork consumers and non-consumers**

Characteristic	Consumers (n =3893) %	Non-consumers (n =608) %	Chi Squared analysis
<b>Sex:</b>			
- Male	54.17	52.68	$\chi^2 = 887.23 (1)$ , p=0.00
- Female	45.83	47.32	
<b>Age group:</b>			
- 2-3 years	2.06	0.93	$\chi^2=120760.87 (7)$ , p=0.00
- 4-8 years	7.25	2.19	
- 9-13 years	8.81	4.46	
- 14-18 years	7.28	4.57	
- 19-30 years	18.57	18.87	
- 31-50 years	29.76	32.81	
- 51-70 years	19.25	27.74	
- 71 years and over	7.00	8.44	
<b>Remoteness:</b>			
- Major cities of Australia	67.72	78.64	$\chi^2 = 61468.22 (2)$ , p=0.00
- Inner regional Australia	21.54	16.09	
- Other	10.74	5.27	
<b>Country of birth</b>			
- Australia	78.65	61.47	$\chi^2 = 394144.95 (2)$ , p=0.00
- Main English speaking country	10.12	5.40	
- Other	11.24	33.14	
<b>SEIFA (Index of Relative Socio-Economic Disadvantage)</b>			
- Lowest 20%	18.72	17.99	$\chi^2=15808.39 (4)$ , p=0.00
- Second quintile	17.25	20.25	
- Third quintile	21.83	18.10	
- Fourth quintile	19.24	21.83	
- Highest 20%	22.96	21.84	
<b>Equivalised income of household<sup>a</sup></b>			
- First decile			$\chi^2=11657.50(9)$ , p= 0.00
- Second decile	9.82	11.69	
- Third decile	6.68	6.26	
- Fourth decile	8.09	9.24	
- Fifth decile	10.01	10.63	
- Sixth decile	12.20	12.54	
- Seventh decile	10.48	9.09	
- Eighth decile	11.66	10.19	
- Ninth decile	10.41	11.61	
- Tenth decile	10.31	8.65	
	10.35	10.09	

<sup>a</sup>Excluding n=470 (income not stated/not known)