FRESH PORK AND CARDIOMETABOLIC HEALTH

Report prepared for the

Co-operative Research Centre for an Internationally Competitive Pork Industry

By

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Executive Summary

High protein meat-based diets are commonly promoted for weight loss, supposedly by increasing both satiety and energy expenditure. Pork is the most widely eaten meat in the world and is a substantial source of dietary protein but, despite its frequency of consumption, there is little evidence of weight loss or other potential cardiometabolic health benefits associated with eating pork. This study investigated the effect of regular consumption of lean fresh pork on cardiometabolic health including body composition and risk factors for diabetes and cardiovascular disease.

We conducted a dietary intervention trial with 144 overweight/obese men and women who were low pork consumers (ate less than one pork meal per week) and were randomised to eat up to 7 serves per week or, alternatively, remain on their customary diet for 6 months. Men and women on the pork diet were provided with 1050g/wk and 750g/wk, respectively, of lean fresh cuts of steak, sausages, diced, mince and stir fry to incorporate into their diet. Cardiometabolic outcomes were measured at baseline and then at 3 and 6 months. They included weight, body mass index, waist/hip circumference and body composition (% body fat, abdominal fat, lean mass), risk factors for diabetes (blood glucose and insulin) and cardiovascular disease (blood lipids, blood pressure, heart rate, large/small artery elasticity index).

Volunteers assigned to the pork diet increased their pork intake 10 fold by substituting pork for other meats in their diets, mainly beef and chicken. On average male volunteers in the pork group consumed 946g per week (135g/d) while female volunteers in the pork group consumed 682g (97g/d) per week. This was done without significant change in intakes of total meat, total energy or macronutrients (fat, protein, carbohydrate).

There was no significant effect on any of the abovementioned risk factors for diabetes or cardiovascular disease. More importantly, compared with those who remained on their customary diet, there were improvements in weight ($P \leq 0.01$), body mass index ($P < 0.02$) and waist circumference ($P \leq 0.03$), body composition, including reductions in % body fat ($P \leq 0.04$), fat mass ($P \leq 0.04$) and abdominal fat ($P \leq 0.01$) after only 3 months. There was no change in lean mass indicating that the reduction in weight was due to loss of fat mass.

These improvements in body composition were achieved without any apparent changes in total energy or protein intake. However, we are unable to say if the improvements were specific to pork or whether consumption of other high protein meat diets may have had the same effect. Our next trial will compare the effect of regular consumption of lean pork with that of two other commonly consumed meats in the Australian diet, viz. chicken and beef, on body composition. We aim to demonstrate that regular consumption of pork is no worse and possibly better than the main alternative meat options in terms of improving indices of body composition.

This project has provided positive evidence that regular consumption of lean fresh pork can reduce body fat while preserving lean mass. Given the increasing prevalence of obesity in Australia, such evidence will reassure consumers that lean pork is a healthy choice, which should strengthen its market relative to its chief competitors. Australian Pork Limited is the most appropriate organisation to deliver this evidence to producers, food industry, regulatory bodies and the consumer.

Table of Contents

Introduction

Rationale and Aim

Pork is the most widely eaten meat in the world and is a substantial source of dietary protein. Despite its frequency of consumption, there is little evidence demonstrating potential health benefits associated with eating pork. Indeed in Australia pork consumption is not as high as in other parts of the world, and this may be partly due to a misconception that pork is an "unhealthy and fatty meat" which may be detrimental to health. However, lean pork is an excellent source of nutrients including protein, vitamins and minerals and may help maintain or improve cardiovascular (CV) and metabolic health when consumed as part of a healthy balanced diet. This study aimed to evaluate the impact of regular consumption of pork on body composition and risk factors for diabetes and CV disease.

Background

Lean pork is a nutritious food containing nutrients including thiamine, niacin, B12, zinc, folate, antioxidants, fatty acids and protein. The Australian Dietary Guidelines recommend one serve of lean meat (~100g) daily as part of a balanced diet to deliver such nutrients. High protein diets can help improve cardiometabolic risk by reducing blood cholesterol levels (1) and improving blood pressure in normal and hypertensive patients (2,3). In fact a number of intervention studies have shown that high protein diets containing lean cuts of meat can improve a number of CV disease risk factors, including improved glucose control and insulin sensitivity, reduced risk of type II diabetes, reduced blood pressure, increased satiety (4) and reduced body weight and improved weight control (5-7). Some of these cardiometabolic risk factors cluster in a condition known as Metabolic Syndrome (MetS), and the clustering of these risk factors results in an almost three-fold increase in the risk of CV morbidity and mortality (8). Therefore, the consumption of pork as part of a balanced diet has the potential to improve risk factors for CV disease and diabetes.

Protein and the metabolic syndrome (MetS)

MetS refers to the clustering of cardiometabolic risk factors - including abdominal obesity, hyperglycaemia, dyslipidemia and hypertension (9). MetS is becoming increasingly prevalent throughout the developed world as populations become more obese, and the incidence of MetS in Australia was recently estimated at 25-30% of adults (10). The health and social costs of MetS is estimated at over $2 billion per year in Australia. Changes in lifestyle habits such as physical activity as well as dietary modification such as reducing saturated fat and increasing omega-3 polyunsaturated fat can counteract these risk factors. Several studies have reported the role of nutrients and functional foods in counteracting chronic disease risk and recent attention has been given to the role that diets rich in lean animal protein might play in reducing CV and metabolic disease.

A variety of dietary approaches including high protein diets to achieve weight loss are consistent with metabolic improvements in CV risk in the short term (5,11-13). Interestingly, most research in this area has focussed on the benefits of red meat: pork has not been studied specifically in terms of its potential to improve CV health and body composition.

Protein, satiety and weight loss

Dietary protein is more satiating than carbohydrate or fat and contributes to weight loss by helping to reduce food intake ad libitum. Numerous studies have demonstrated an association between the consumption of lean red meat and increased satiety and weight loss. It is thought that high meat protein diets may enhance weight loss by increasing satiety, leading to a reduced energy intake, while at the same time increasing thermogenesis which then blunts the normal fall in energy expenditure generally seen in weight loss (11). For example, Skov et al (14) demonstrated reductions in body fat and body weight on a high protein diet compared with a diet rich in carbohydrate over 6 months. Similarly, Parker et al (4) demonstrated reductions in body weight for men and women following the consumption of a high protein diet for 3 months, with women losing more total fat and abdominal fat than men. In a more recent study, Gardner et al (15) found that, compared with the LEARN (low fat diet), Ornish (low fat, vegetarian diet) and Zone (40/30/30 carbohydrate/fat/protein) diets, the Atkins diet (high protein, high fat, low carbohydrate) led to greater weight loss and more favourable metabolic outcomes after 1 year. Other high protein, but energy restricted, diets also have been shown to be successful in achieving weight loss and weight maintenance (4-7). These diets generally contain around 30% energy derived from protein (equating to around 2-3 serves of animal protein daily), predominantly lean cuts of red meat as part of an isocaloric diet (energy intake ~<6000kJ).

Protein and blood pressure

In the INTERSALT study, Stamler and colleagues (3) demonstrated a significant inverse association between blood pressure and 24-hour urinary excretions of total nitrogen and urea nitrogen (markers of dietary total protein). These markers were significantly related to systolic blood pressure (SBP) and diastolic blood pressure (DBP) in multiple linear regression analyses adjusted for age, sex, BMI, alcohol intake, and 24-hour urinary excretions of sodium, potassium, calcium, and magnesium. Estimates from this study indicate that an increase in protein intake of 37g/day would be associated with reductions in SBP and DBP of approximately 3 and 2.5mmHg, respectively. Similarly, Delbridge et al (16) demonstrated a 6.6mmHg lower SBP in individuals consuming a high protein diet for 12 months compared with individuals randomised to consume a high carbohydrate diet.

Protein and blood lipids

Several studies have shown benefits of including lead red meat in the diet on reductions in blood cholesterol. Parker et al (4) found that 3 months on a high protein diet reduced total cholesterol, triglycerides and LDL cholesterol. In studies that have reduced fat intake, lean red meat consumption has also been associated with reductions in total cholesterol (17,18). Whereas in another study when 500g/day of lean beef was given in addition to a low fat diet, blood cholesterol decreased by 20% but increased when beef fat was added back in to the diet suggesting that the lean cuts of beef were responsible for the reduction in blood cholesterol (19).

Protein and insulin sensitivity

High protein, energy restricted diets used specifically for weight loss have been shown to have positive effects on blood glucose regulation (6) and insulin sensitivity, with these benefits primarily being a result of weight loss while preserving lean tissue mass (6,20). McMillan-Price et al (21) demonstrated that consumption of a medium protein diet (25%en from protein) with either high or low glycemic index for 3 months resulted in a mean reduction of ~6% in body weight, ~6cm reduction in waist circumference and a 4kg decrease in fat mass as measured by dual energy xray absorptiometry (DEXA).

Does pork deliver the same benefits as lean cuts of red meat?

Rubio and colleagues (22) compared the effects of lean pork and veal consumption (150g/day) on blood lipids in healthy individuals. The authors demonstrated a ~6% reduction in LDL cholesterol for both groups, but found <u>no difference</u> between the groups after 6 weeks, indicating that pork is just as effective as red meat for improving CV risk factors. However, given that pork has a similar nutrition profile to red meat (see Table 1), there is little reason why regular consumption of lean fresh pork, cannot deliver the same or even greater CV health benefits than lean red meat.

Table 1. Energy and nutrient composition of lean pork and beef.

Per 100g	Pork, butterfly steak, trimmed of fat	Beef, fillet, lean
Energy (kJ)	746	746
Protein (g)	31.5	31.9
Fat (g)	5.7	5.5
SFA (g)	2.2	1.8
MUFA (g)	2.4	2.4
PUFA (g)	0.7	0.6
Cholesterol (mg)	127	70
Thiamine (mg)	1.34	0.03
Niacin (mg)	7.9	1
Sodium (mg)	46	49
Potassium (mg)	438	350
Calcium (mg)	7	10
Iron (mg)	0.7	2.2
Zinc (mg)	2.2	7.8

Source: NUTTAB 2006 online version

How can we assess the relationship between pork intake and cardiometabolic risk?

While several studies have investigated the effect of high protein diets (red meat) on weight loss and CV disease risk factors, few studies have investigated the effect of lean pork consumption on body composition and risk factors for CV disease and diabetes.

Methodology

Subjects, design and dietary groups

A total of 144 (n=72 pork, n=72 control) free-living, overweight/obese (body mass index, ≥25 kg/m^2) men and women who habitually ate ≤100g pork per week completed this randomised, controlled, dietary intervention trial. Subjects were randomly allocated to one of two groups matched for body mass index (BMI), age, and gender. Group 1 consumed ad libitum, i.e. without energy restriction a pork diet while group 2 maintained their customary diet (C, control) for 6 months.

Subjects assigned to the pork group were provided with lean cuts of pork steak, stir fry, diced, mince, sausages and asked to incorporate the allocated pork into their usual diet. Men were asked to consume 1050g/week and women 750g/week. Inclusion of these quantities of pork was based on consumption patterns of protein from muscle meat (pork, beef, veal etc) for men and women (23) and equated to a medium protein diet based on an average energy intake of 8500 kJ/day. Subjects in the pork group had their body weight recorded fortnightly and returned pork consumption logs to accurately track consumption of the provided pork.

Exclusion criteria

Subjects were excluded if they were taking medications at doses that had not been stabilized for more than 6 months; were ≥135kg (since this exceeds the capability for DEXA scanning to assess body composition) or reported one of the following: diagnosed diabetes or cardiovascular disease; liver or renal disease (plasma creatinine >120 μmol/L); were using appetite suppressants or Orlistat (Xenical); were eating more than one pork meal per week or unable to consume pork for 6 months.

Compliance

Compliance to the dietary intervention was assessed at baseline, 3 and 6 months using pork consumption logs where subjects recorded their daily consumption of provided pork and pork intake from food frequency questionnaires. Subjects were asked to maintain their normal physical activity throughout the study which was assessed at the same time-points as dietary intake using 3-day physical activity diaries.

Outcomes measures

The primary outcome measure was % body fat. Secondary outcomes were weight, BMI, waist/hip circumference, fat mass, abdominal mass, blood pressure, arterial compliance, blood lipids, glucose and insulin.

Clinical:

Dietary intake;

Detailed dietary data was collected using the Cancer Council of Victoria's validated food frequency questionnaire (FFQ) at baseline and 3 and 6 months of the study. Dietary intake measured the type of food and beverage, portion size and frequency of consumption. Energy and macronutrient intake (fat, protein and carbohydrate) was adjusted according to the macronutrient profile of moisture infused pork.

Physical activity;

Subjects recorded all physical activity conducted in a 24hr period over 3 days in a physical activity diary (adapted from Bouchard et al. (24)). Energy expenditure (kcal) was calculated for every 15 minute period in a 24 hour day according to 9 categories of different types of activity (eg. sleeping, playing sports, gardening etc) and multiplied by the appropriate physical activity level factor for the reported intensity of exercise. This was multiplied by body weight, then averaged for 3 days and converted to kilojoules to give total energy expenditure in kilojoules per day.

Anthropometry (weight, height and BMI, waist and hip circumference);

Body weight was measured at baseline and every fortnight during the intervention using an electronic scale with subjects wearing minimal clothing and without shoes. Height was measured with subjects bare feet. BMI was calculated according to the following calculation: BMI= weight (kg)/ height $(m)^2$. Waist circumference (WC) and hip circumference (HC) were assessed to calculate waist/hip ratio.

Body composition (% body fat, abdominal fat and lean mass);

Body composition was assessed by Dual Energy X-Ray Absorptiometry (DEXA; *GE Lunar Prodigy Oracle*) to determine % body fat, fat mass, abdominal fat and lean mass.

Blood pressure and arterial compliance;

Blood vessel function was assessed using the HDI PulseWave CR-2000 instrument. Resting blood pressure and heart rate was recorded whilst supine by automated oscillometry. Indices of compliance in proximal (capacitance) and distal (resistance) arteries were derived from a series of three measurements.

Biochemical

Blood lipids;

Plasma total cholesterol, HDL cholesterol and triglyceride concentrations were measured in a single run at the end of the study using a Konelab 20XTi analyser (Thermo Electron Corporation) with standard enzymatic kits. LDL cholesterol was calculated using the Friedewald formula (25).

Insulin sensitivity (blood glucose and insulin);

Fasting plasma glucose was analysed using the Konelab 20XTi analyser (*Thermo Electron Corporation*) using a standard enzymatic kit. Insulin was measured using a radioimmunoassay kit (*Linco Diagnostics*) according to standard procedures.

Statistical analysis

Differential effects of the diets on the outcome measures over time were determined using two-way analysis of variance with repeated measures. Significance was set at $P<0.05$.

Outcomes

Baseline characteristics

Participants in both groups were middle aged, obese (according to BMI), with normal blood pressure but were borderline for high cholesterol, LDL cholesterol, triglycerides and glucose. There were no differences between groups at baseline (see Table 2).

Table 2. Baseline characteristics of volunteers in the pork and control groups[1].

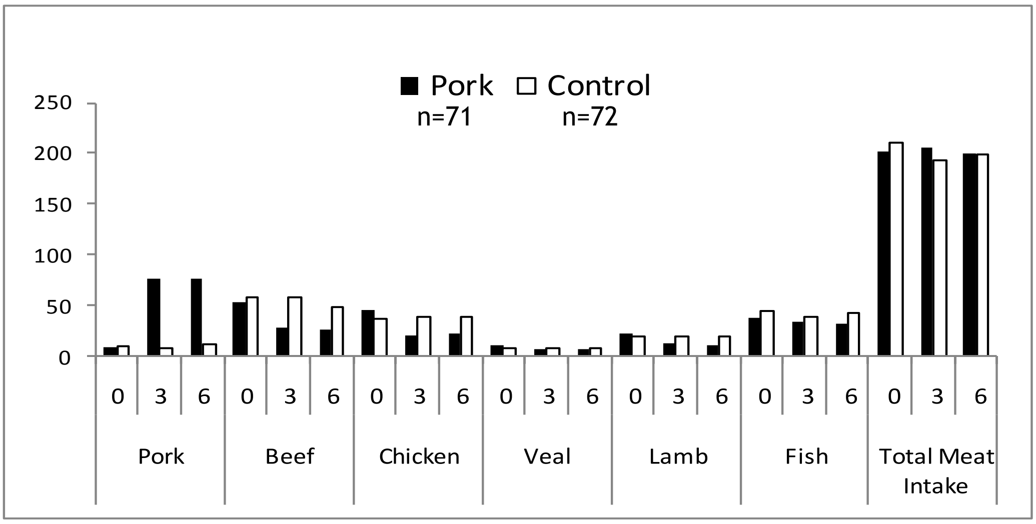
	n	Pork n=72	*n*	Control n=71
Age (years)	*73*	48 ± 12	*72*	48 ± 12
Weight (kg)	*72*	91.4 ± 17.6	*72*	92.6 ± 16.8
Height (m)	*72*	1.7 ± 0.1	*72*	1.7 ± 0.1
Body Mass Index (kg/m^2)	*72*	31.8 ± 5.4	*72*	31.9 ± 4.3
Systolic Blood Pressure (mmHg)	*72*	127 ± 2	*72*	127 ± 2
Diastolic Blood Pressure (mmHg)	*72*	73 ± 1	*72*	72 ± 1
Total Cholesterol (mmol/L)	*73*	5.6 ± 0.1	*71*	5.7 ± 0.1
LDL cholesterol (mmol/L)	*72*	3.8 ±1.0	*69*	3.7 ± 0.1
HDL cholesterol (mmol/L)	*73*	1.2 ± 0.05	*71*	1.4 ± 0.04
Triglycerides (mmol/L)	*72*	1.5 ± 0.09	*69*	1.4 ± 0.1
Insulin (μU/mL)	*68*	20.5 ± 1.0	*67*	19.4 ± 0.8
Glucose (mmol/L)	*72*	5.9 ± 0.07	*70*	5.9 ± 0.1

[1]Values are mean ± standard deviation.

Compliance with pork consumption

Average consumption of provided pork was calculated from the daily pork consumption logs. Men in the pork group were provided with 1050g of fresh lean pork per week and consumed 946g per week (135g/d) on average. Women in the pork group were provided with 750g of fresh lean pork per week and consumed 682g (97g/d) per week on average. According to baseline intakes of pork as estimated from the food frequency questionnaire, men and women were consuming 8g/d and 7g/d, respectively, prior to commencement of the study and increased their intakes up to 10 times to 90g/d and 65g/d, respectively (see Fig 1), whereas intakes of the two main meats in the diet, namely beef and chicken, halved by 6 months. Intakes of lamb decreased slightly, however there was no change in consumption of veal or fish. These data indicate that volunteers were able to incorporate lean fresh pork into their habitual diet by substituting with beef and chicken. This was done without impacting on total meat intake.

Figure 1. Intakes of meat (g/day) at baseline, 3 and 6 months for the pork and control group as estimated from the Food Frequency Questionnaire[1].



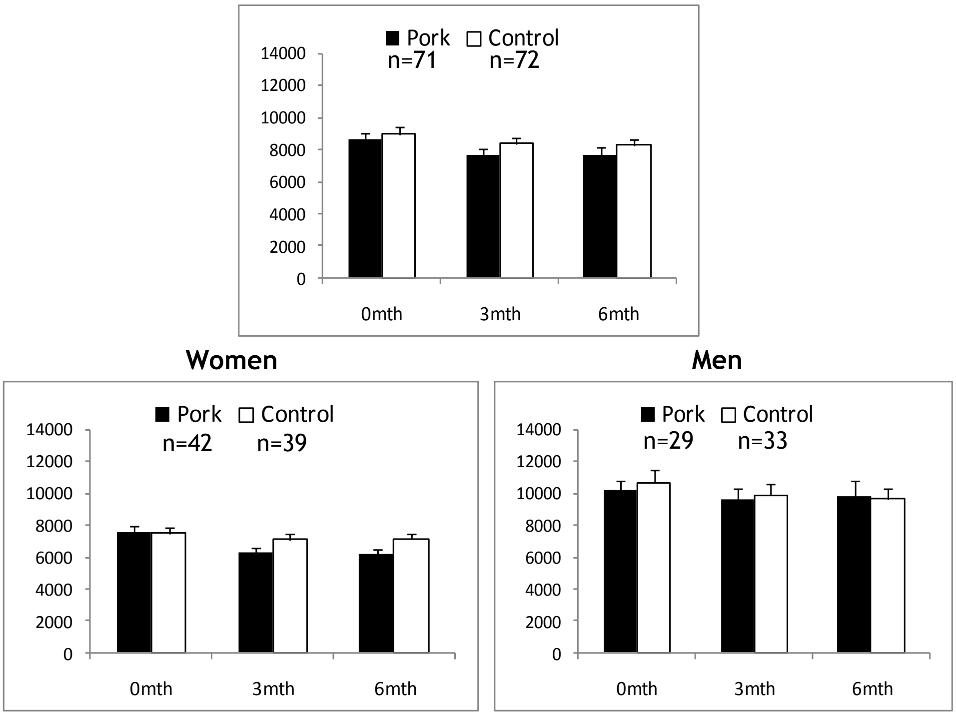
Dietary Intake & Physical Activity

Total energy and macronutrient intakes were adjusted for the nutrition profile of moisture infused pork. There was no difference in energy intake (kJ) (see Fig 2a) or macronutrients (total fat, protein or carbohydrate, see Fig 2b) between groups over time. This indicates that volunteers were substituting meats in their diet without impacting on the total amount of meat eaten or the amount of energy or total protein consumed.

There was no difference in total energy expenditure (kJ/d) according to the physical activity diaries, indicating volunteers did not change their physical activity levels or energy expenditure during the intervention (see Fig 3).

Neither energy intake or energy expenditure changed significantly in the pork consumers or the control group during the intervention. The discrepancy between the amount of energy consumed (energy intake) and the amount expended (energy expenditure) reflects the lack of reliability to assess energy intake and expenditure, nevertheless we were examining within individual changes

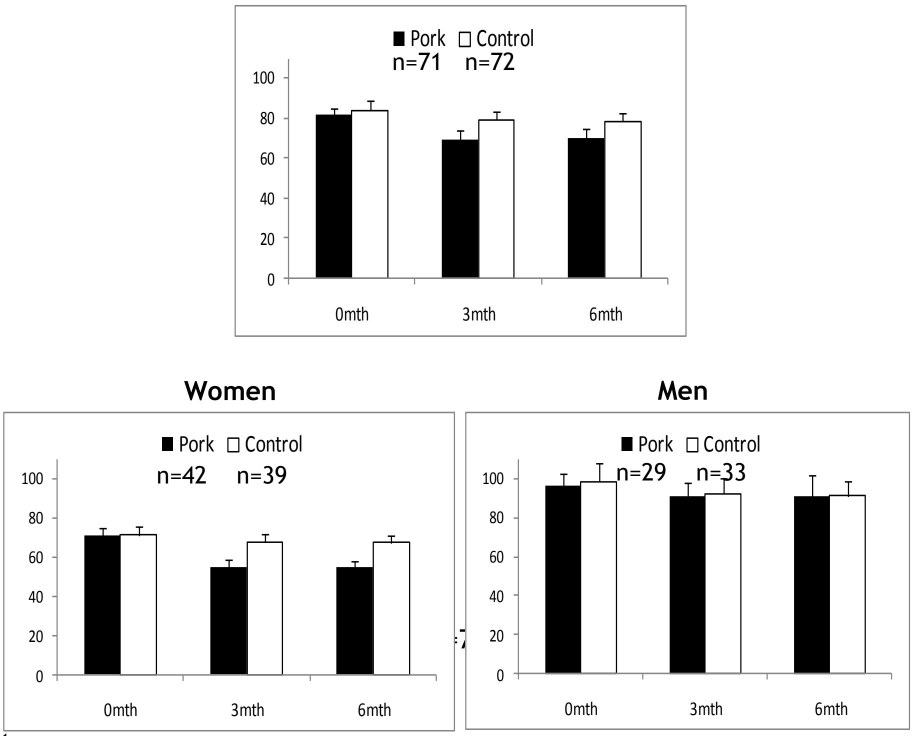
Figure 2a. Energy intake (kJ/day) at baseline, 3 and 6 months for pork and control groups and by gender as estimated from the Food Frequency Questionnaire[1].



[1]Values are mean ± standard error. Values adjusted for nutrition profile of moisture infused pork.

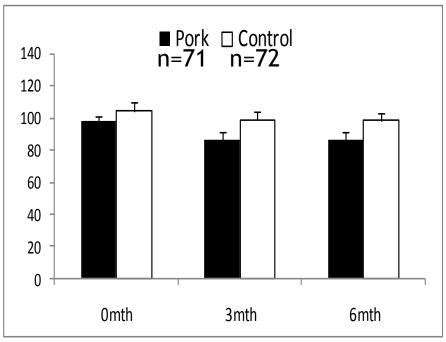
Figure 2b. Macronutrient intake: fat (g/day), protein (g/day), carbohydrate (g/day) at baseline, 3 and 6 months for pork and control groups and by gender as estimated from the Food Frequency Questionnaire[1].

Fat (g/d)

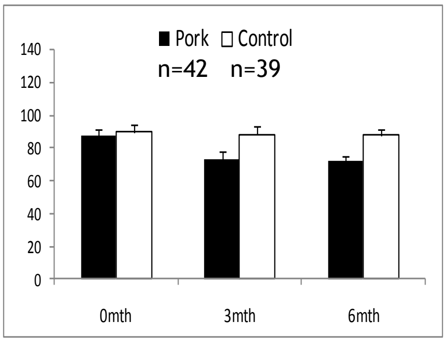


[1]Values are mean ± standard error. Values adjusted for nutrition profile of moisture infused pork.

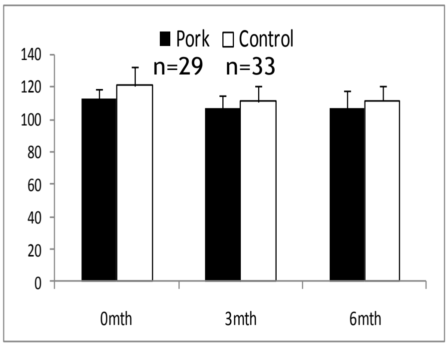
Protein (g/d)



Women

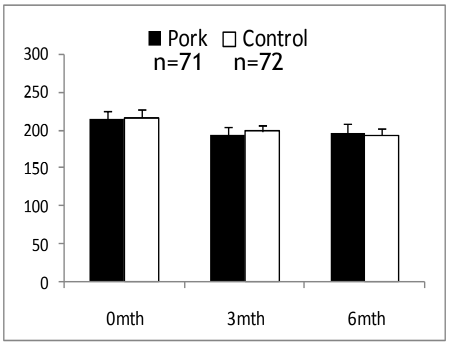


Men

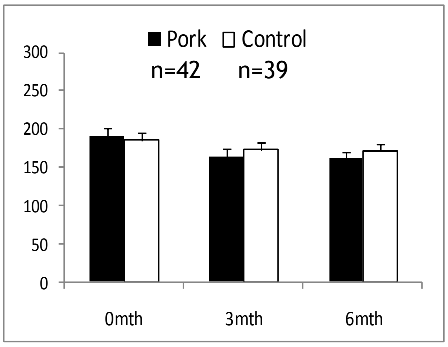


[1]Values are mean ± standard error. Values adjusted for nutrition profile of moisture infused pork.

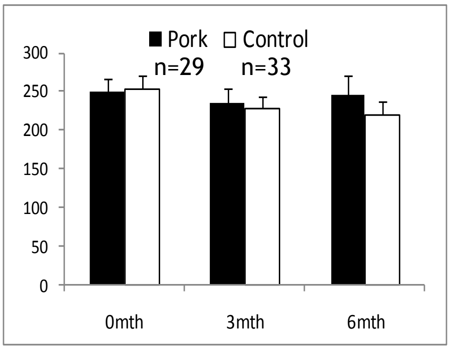
Carbohydrate (g/d)



Women

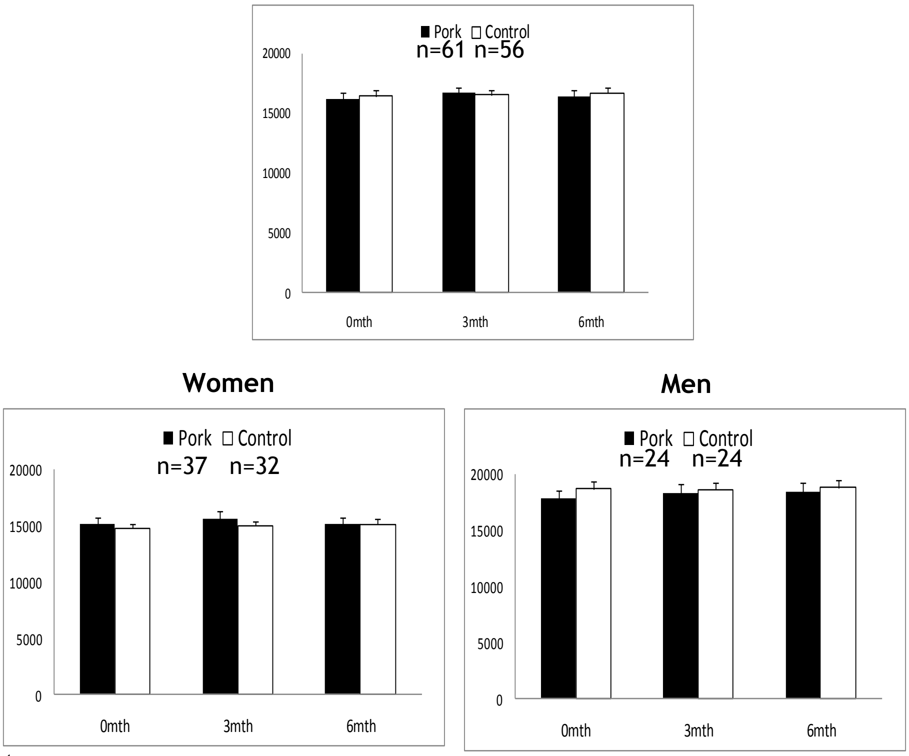


Men



[1]Values are mean ± standard error. Values adjusted for nutrition profile of moisture infused pork.

Figure 3. Total energy expenditure (kJ/day) for pork (n=61) and control (n=56) groups and by gender at 3 months and 6 months[1].



[1]Values are mean ± standard error.

Cardiometabolic Function

All volunteers had normal values for systolic and diastolic blood pressure and heart rate but borderline high levels of total cholesterol, LDL cholesterol and plasma glucose at baseline. There were no changes over time in any cardiovascular or metabolic parameter measured in either the pork or control groups (see Tables 3 and 4).

Table 3. Blood vessel function of volunteers in the pork and control groups at baseline, 3 months and 6 months[1].

	Pork				Control			
	n				n			
Systolic BP[2]	*72*	126±2	123±1	124±1	*72*	127±2	125±1	126±2
Diastolic BP[2]	*72*	73±1	71±1	71±1	*72*	71±1	70±1	70±1
Heart rate[3]	*72*	62±1	61±1	60±1	*72*	61±1	61±1	60±1
Large artery EI[4]	*72*	17.1±0.5	16.4±0.5	16.8±0.5	*71*	16.7±0.6	16.3±0.5	16.3±0.5
Small artery EI[4]	*72*	7.9±0.4	7.9±0.4	8.1±0.4	*71*	8.3±0.4	8.8±0.5	8.6±0.5

[1]Values are mean ± standard error. [2]mmHg; [3]bpm; [4]EI; elasticity index, mL/mmHg x 10.
BP, blood pressure; EI, elasticity index.

Table 4. Blood lipids, glucose and insulin levels of volunteers in the pork and control groups at baseline, 3 months and 6 months[1].

	Pork				Control			
	n				n			
TC[2]	73	5.7±0.1	5.6±0.1	5.5±0.1	71	5.8±0.1	5.7±0.1	5.6±0.1
LDL-C[2]	72	3.7±0.1	3.6±0.1	3.6±0.1	69	3.7±0.1	3.7±0.1	3.6±0.1
HDL-C[2]	73	1.3±0.03	1.3±0.03	1.3±0.03	71	1.4±0.3	1.4±0.03	1.3±0.03
Trig[2]	72	1.5±0.1	1.4±0.1	1.3±0.1	69	1.4±0.1	1.4±0.1	1.3±0.1
Glucose[2]	72	5.9±0.1	5.8±0.1	5.8±0.1	70	5.8±0.1	5.9±0.1	5.9±0.1
Insulin[3]	68	20.6±1.1	19.6±1.0	18.5±0.9	67	19.4±0.8	18.6±0.9	18.8±0.8

[1]Values are mean ± standard error. [2]mmol/L; [3]µU/mL.
TC, total cholesterol; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol; Trig, triglycerides.

Body composition

Body composition was assessed using anthropometry (weight, height, BMI, waist/hip circumference) and DEXA to determine % body fat, fat mass, abdominal fat and lean mass.

Compared with those who remained on their customary diet, there were improvements in body composition including reductions in % body fat ($P \leq 0.04$), weight ($P \leq 0.01$), body mass index ($P < 0.02$), fat mass ($P \leq 0.04$), abdominal fat ($P \leq 0.01$) and waist circumference ($P \leq 0.03$) in the pork group after only 3 months (see Fig 4). There was no change in lean mass which indicates that the reduction in weight was due to a loss of fat mass.

Figure 4a. Change in body fat (%) for pork (n=72) and control groups (n=71) and by gender at 3 months and 6 months.

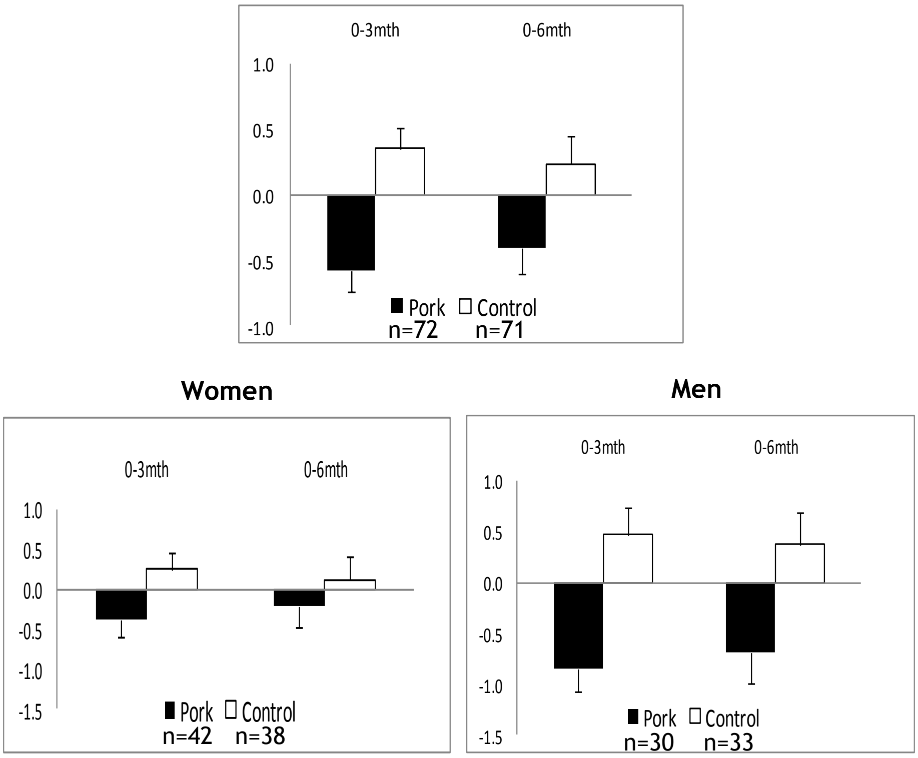


Figure 4b. Change in weight (kg) for pork (n=72) and control groups (n=72) and by gender at 3 months and 6 months.

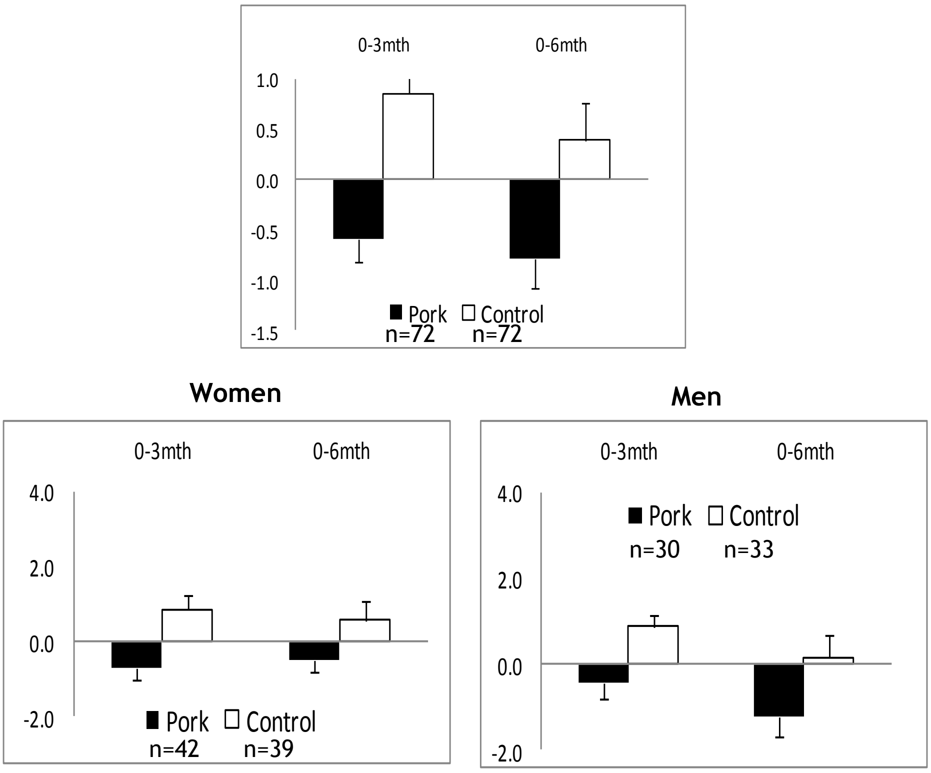


Figure 4c. Change in body mass index (kg/m^2) for pork (n=72) and control groups (n=72) and by gender at 3 months and 6 months.

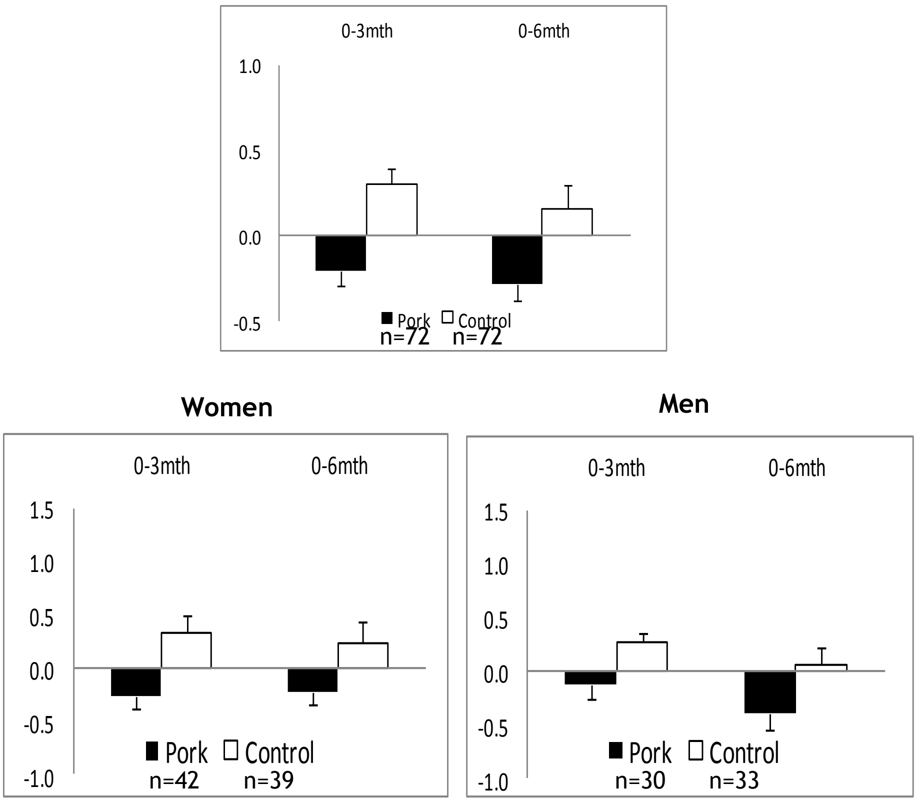


Figure 4d. Change in fat mass (kg) for pork (n=72) and control groups (n=71) and by gender at 3 months and 6 months.

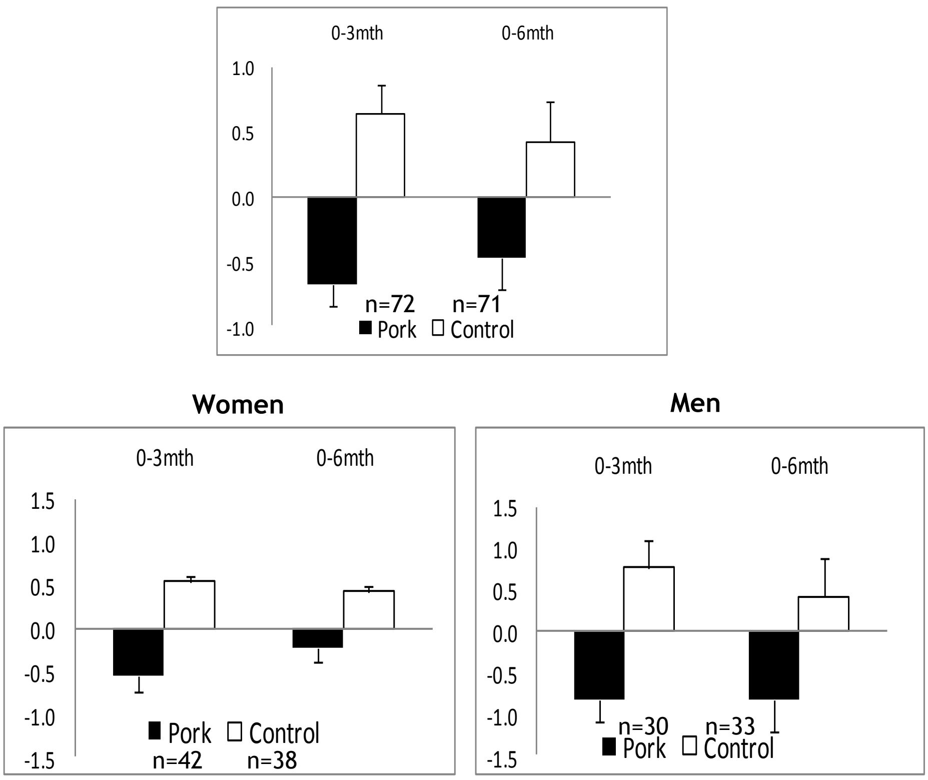


Figure 4e. Change in abdominal fat (kg) for pork (n=72) and control groups (n=71) and by gender at 3 months and 6 months.

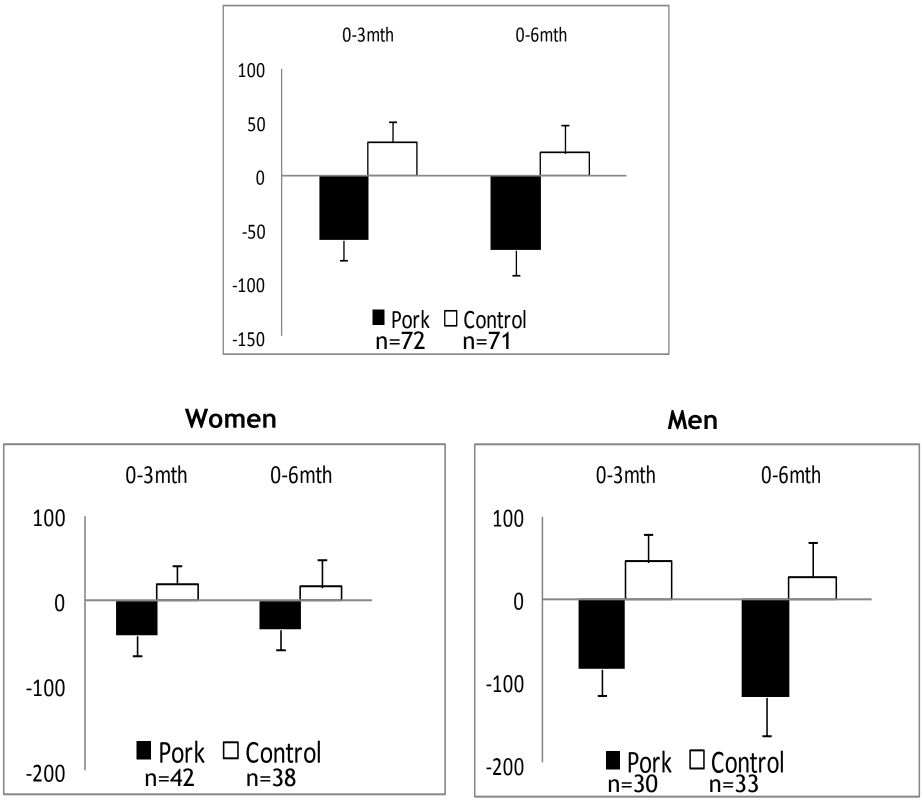


Figure 4f. Change in waist circumference (cm) for pork (n=72) and control groups (n=71) and by gender at 3 months and 6 months.

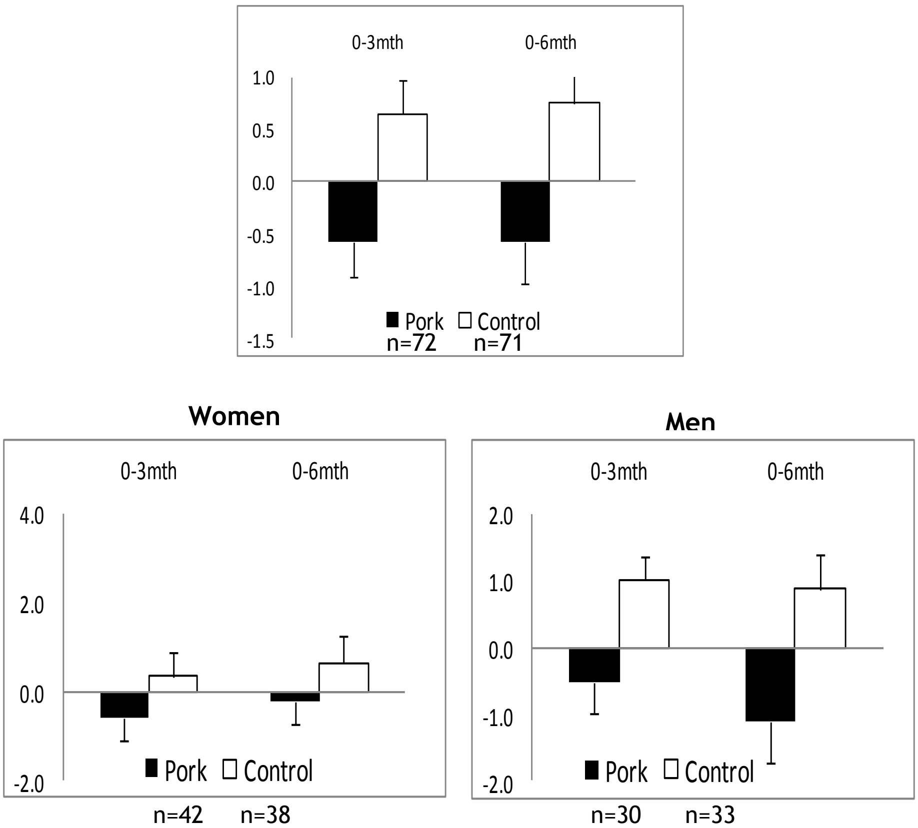
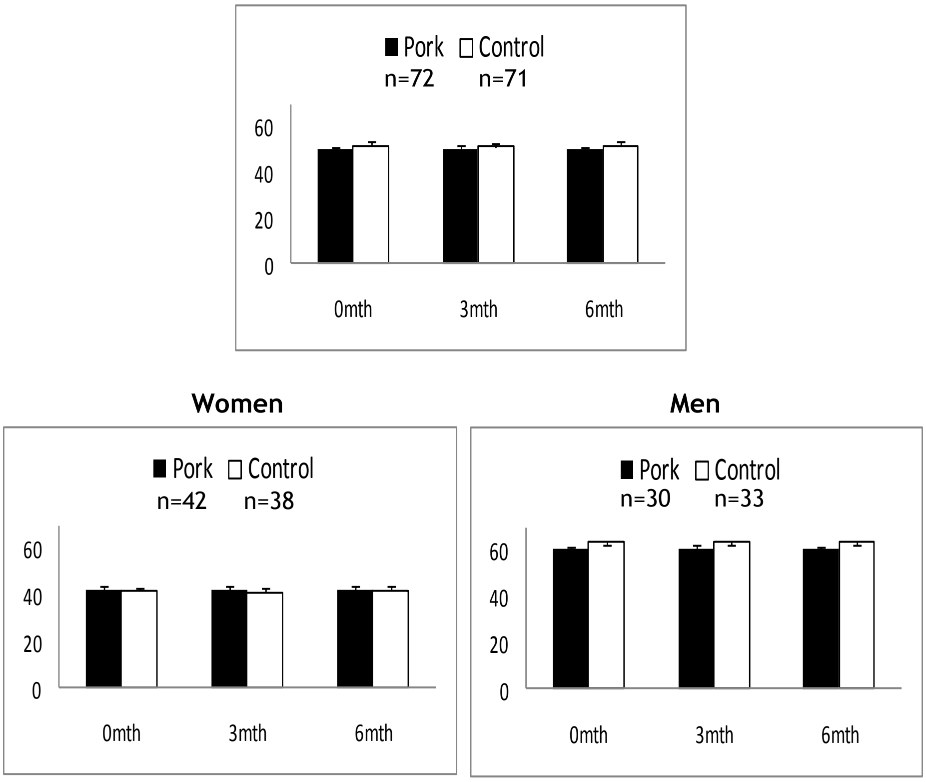


Figure 4g. Lean mass (kg) for pork (n=72) and control groups (n=71) and by gender at 3 months and 6 months.



Discussion

The results of the present study show that fresh lean Australian pork can be incorporated into an individual's regular diet without any adverse effect on risk factors for diabetes or cardiovascular disease, but may actually improve cardiometabolic health by favourably influencing body composition. These data show that regularly consuming up to 7 serves of lean pork per week can reduce body weight and waist circumference by reducing fat mass and abdominal fat mass while preserving lean mass. These improvements in body composition were achieved without energy restriction or changes in physical activity levels, total meat or protein intake, indicating that they are unlikely to be a general protein related effect.

Studies have shown that protein appears to be superior to carbohydrate in promoting satiety (reducing hunger and food intake) and diet induced thermogenesis (greater energy expenditure and less fat storage) (26) contributing to weight loss. It is thought that high protein diets may enhance weight loss by increasing satiety, leading to a reduced energy intake, while at the same time increasing thermogenesis, which then blunts the normal fall in energy expenditure generally seen in weight loss (27). Interestingly a paper by Mikkelsen and colleagues (26) showed greater 24hr energy expenditure (thermogenesis) following a pork diet compared with a soy diet where fat and protein levels were matched and energy intakes were lower on both diets (due to satiating effect of the high protein diet). It appears that the thermogenic effect of protein depends on the type of protein and it may be that the type and amount of amino acids present in pork protein favour increased protein synthesis and turnover rate which in turn increases thermogenesis and energy expenditure leading to less fat deposition.

As we did not measure satiety we cannot rule out a satiety related effect. This would imply a change in energy intake however there was no significant effect in energy intake in the current study. We are also unable to say if the improvements were specific to pork or whether consumption of other high protein meat diets may have had the same effect. Our next study will investigate the effect of regular consumption of lean fresh pork with two of the most commonly consumed meats in the Australian diet, namely chicken and beef on body composition and energy intake and physical activity levels. This study will help elucidate if there is a possible specific benefit of pork in terms of energy intake and body composition.

Application of Research

Application of the research findings in the commercial world.

Commercialization/Adoption Strategies

Our research will be promoted through conference presentations at national meetings and through peer reviewed scientific journals supporting the health benefits of lean pork consumption. To communicate these results to the general public as well as health care providers, industry and producers, a marketing campaign using media like radio, television and newspapers will help disseminate our results and help revitalize the image of pork. Pork has been previously thought of as an unhealthy and fatty meat. However, we have shown that including lean pork in the diet has no adverse effect on cardiometabolic health.

Opportunities uncovered by the research

This project is the first large scale randomized controlled trial to provide evidence that regular consumption of lean fresh pork has no adverse effect on risk factors for CV disease or diabetes but favourably impacts on body composition without the need for energy restriction. This is an important finding for the Pork CRC as it will help revitalise the image of pork as a healthy meat choice.

The improvement in body composition following pork consumption cannot simply be attributed to appetite suppression be we are unable to say if the improvements were specific to pork or whether consumption of other high protein meat diets may have had the same effect. Further research is required to determine if other meats have a similar effect on body composition if regularly consumed. Therefore in the next APL/Pork CRC funded trial, we will compare the effect of regular consumption of lean pork with that of two other commonly consumed meats in the Australian diet, namely chicken and beef, on body composition in a 9 month cross over trial. We aim to demonstrate that regular consumption of pork is no worse and possibly better than the main alternative meat options in terms of improving indices of body composition.

Impact of the research

This project is scientifically important, as it will provide the pork industry, regulatory authorities and Australians with new evidence that the consumption of pork does not increase, but may in-fact reduce, the risk of CV or metabolic disease. Australian Pork Limited together with the Pork CRC, is the most appropriate organisation to deliver this evidence to producers, food industry, regulatory bodies and the consumer. Given the current obesity epidemic in the developed world, this project will provide the Australian Pork industry with substantial new local and export marketing opportunities which will return financial benefit to producers.

Furthermore, this project has the potential to benefit all Australians. The primary target group to benefit from this project is the majority of Australians who consume meat including pork. As in most other developed countries throughout the world, Australia is experiencing an obesity epidemic, resulting in an increasing prevalence of MetS. This epidemic represents the greatest health crisis of our time. At the same time, this epidemic represents an enormous opportunity for producers, food manufacturers and distributors of products which can counter the adverse effects of obesity and improve metabolic health.

Conclusion

Lean fresh Australian pork can be included in the diet without adversely affecting risk factors for diabetes and cardiovascular disease; instead it may improve body composition.

Limitations/Risks

n/a

Recommendations

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

- Undertake a further study to compare the effects of regular consumption of lean pork on body composition and energy intake with chicken and beef (agreement signed). This project will aim to demonstrate that regular consumption of pork is no worse and possibly better than the main alternative meat options in terms of improving indices of body composition.

- Public dissemination of results using a marketing campaign to revitalize the image of pork

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Appendix 1 - Notes

Appendices

Appendix 1:

n/a