final report

Project Code: D.MHN.0017

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University of New England

Date published: April 2008

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Iron status of a female university student population

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

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Acknowledgements

The project team gratefully acknowledges the financial support from MLA, without which the study would not have been possible. We would like to thank the respondents for their participation, their interest, and their time. The contribution of UNE Medical Centre staff who took time out of their very busy clinic practice work to assist with the study deserves special mention. We could not have obtained the results of this study without the valuable assistance provided by Fiona Utley and Karin Fisher. We are indebted to both for their meticulous work. The work of the Pathology New England team was vital to the process and much appreciated.

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Abstract

Iron deficiency is related to a decrease in general health and well-being. There are only two previous Australian studies on iron status of university students, and both were conducted in large cities (Perth & Sydney). No study has been undertaken in a rural university campus setting on prevalence of iron deficiency anaemia and associated risk factors. The present study was a pilot project undertaken by the University of New England to assess the iron status of the female university student population.

Although a large majority (91.6%, n=328) reported eating red meat, adequate levels of red meat consumption (3 or more serves per week) were reported by only 51% (n=184). Nearly two-thirds of the sample lived in university accommodation, over half in whom lived in fully catered colleges. The prevalence of iron deficiency was 11.9%. Over a third (37.4%) of the study sample perceived themselves to be iron deficient.

This study provides a useful baseline to explore issues in dietary behaviour and developing effective health promotion messages regarding the importance of adequate nutrition for university students. A more comprehensive study into the link between iron deficiency and impaired cognitive abilities is also needed.

Executive Summary

To our knowledge no study has been undertaken in a rural university campus setting on prevalence of iron deficiency anaemia and associated risk factors. There are only two previous Australian studies which have investigated iron status of university students, and both studies were conducted in urban regions (Perth & Sydney).

A pilot project was undertaken by the University of New England to assess the iron status of the female university student population. The study was funded by a project grant from Meat & Livestock Australia (MLA) Limited.

Iron deficiency is related to a decrease in general health and well-being, which can be both physical and mental. Iron deficiency may manifest in different forms including impaired exercise capacity and endurance, poor immune function and decreased work performance, with consequent increased susceptibility to infection, and fatigue. Iron deficiency can also impair cognitive function, with concentration and short term memory being the functions most likely to be affected. Giving supplemental iron to girls with non-anaemic iron deficiency has been shown to improve their verbal learning and memory. Prevalence rates for iron deficiency (based on serum ferritin levels) in females aged 15-49 in Europe, North America and New Zealand range from 6-29%, with a median rate of 10%.

Keeping the above in mind, the aim of the pilot study was to obtain baseline data of iron status in young female university population who sought care at the University of New England's Medical Centre (UNE) in Armidale, New South Wales. The primary objectives of the study included:

- To determine the proportion of female students attending UNEMC who have risk factors for iron deficiency on the basis of their responses to a detailed questionnaire.
- To determine the prevalence of iron deficiency amongst those students who were considered to potentially iron deficient based on one of more affirmative responses to the risk factors in the questionnaire and clinical assessment.

The study was conducted over a period 1st September 2006 to 28th August 2007. A total of 360 participants were included in the study. Complete data was available on 358 of the participants. Results of blood tests were available for 46% (n=165) participants. The data from the questionnaires and pathology laboratories (ie, on blood tests) were entered into Microsoft Excel and were analysed using the statistical software SPSS. Extensive cross-checks were undertaken, both manually and through the available software, over several weeks to ensure accuracy of available information.

The key results of the study are summarised below. Additional information is contained in the full report.

- The mean age was 20.3 (SD, 2.7) years. Although the age range showed wide variation (18-41 years), 67% (n=240) were aged 20 years or below and 96% of the sample was aged 25 years or younger. The majority of the students were from non-indigenous backgrounds, with only two of the 358 respondents reporting to be of Aboriginal. Overseas students comprised 1.7% of the sample.
- Nearly two-thirds of the study sample lived in university accommodation of which 59.2% (212) lived in fully catered colleges, while 9% had a self-catering arrangement.

- Although a large majority (91.6%, n=328) reported eating red meat, adequate levels of red meat consumption (3 or more serves per week) were reported by only 51% (n=184).

- The most frequent reasons for not eating red meat were: meat provided is not appealing (23.2%); did not like the taste of meat (17%); to save money (9.2%); want a healthier diet (7.8%); and study limits time to purchase/cook (7.8%).

- The proportions of the sample reporting any of the other 3 risk indicators for iron deficiency were 11.5% (heavy menstrual blood loss), 26.0% (prior history of iron deficiency anaemia as diagnosed by a doctor), 37.4% perceived themselves to be currently (at time of consultation) iron deficient based on one or more symptoms (tiredness, low energy, dizziness, infections or pallor).

- The results of the present study show that the prevalence of iron deficiency was 11.9%.

This study provides a useful baseline to explore issues in dietary behaviour and developing effective health promotion messages regarding the importance of adequate nutrition for university students. To increase awareness of the importance of red meat and its link with physical and mental health, there is a potential for the industry to sponsor seminars and workshops in rural locations such as UNE campus in Armidale, where students can engage in debate on food choices and be better informed of the caloric value of food. To ensure that such events were of value, pre- and post-event evaluations could be planned to assess the improvement in health literacy in general and dietary knowledge in particular.

As a large proportion of students lived in catered college accommodation, there is an opportunity both for the university and the industry to review incentives for residential colleges which encourage them, within their existing budgets, to increase students' red meat intake by offering a better variety and more appealing menu of meat dishes.

The present pilot study could also be used by MLA to fund a definitive study which demonstrates improvement or otherwise in the cognitive abilities of students undertaking a variety of courses from psychology to mathematics who have demonstrated iron deficiency, with or without anaemia. Students who have been involved in this present study could be a starting point for an extension of the study. As shown by the present study, most students are interested in being healthy and believe that healthy eating does affects their sporting and academic abilities.

Contents

1 Background

1.1 Literature review

1.1.1 Iron metabolism

Iron is an essential dietary element required for oxygen transport, cellular metabolism and genetic transcription[1]. Adequate iron stores are important for muscle tissue aerobic capacity and aerobic endurance [2].

Absorption and retention of iron is dependent on the amount and bioavailability of iron in the diet [1]. There are two forms of dietary iron- haem (found in meat, fish and poultry), and non-haem (from plant foods and iron fortified foods)[3]. Haem sources of iron generally have a higher bioavailability than non-haem sources[3]. The recommended dietary intake or iron is 18mg per day for adolescent females[4]. To attain this level of iron intake, it is recommended that red meat be eaten 3-4 times per week[5]. Alternate sources of iron include wholegrain breads and cereals (especially iron-fortified cereals), dried fruits, nuts, legumes (chickpeas, kidney, soya beans etc.) and green leafy vegetables (although the iron in the latter is largely inhibited from absorption by the phytates in the leaves).

Dietary iron is absorbed from the small intestine, and is then transported to the bone marrow by transferrin, where it is used to synthesise haemoglobin[3]. Iron that is superfluous to daily requirements is stored as ferritin[1]. Iron in the body is tightly conserved, however, small daily losses occur through the gut, skin and kidneys. Significant losses may occur through menstruation and gastrointestinal sources of bleeding[3].

Biochemical markers of iron status commonly include plasma iron, ferritin, transferrin and transferrin saturation. Blood haemoglobin levels can be used to determine the presence of anaemia. Ferritin level changes in parallel to iron stores, and is therefore generally considered to be the best guide for ascertaining body iron stores[6]. All these markers may be affected by dehydration, recent exercise, infection, inflammation or malignancy[6]. Reticulocyte count, free erythrocyte protoporphyrin[7], and reticulocyte haemoglobin content [8] may be additionally helpful in confirming iron deficiency. The addition of ESR or CRP may assist in determining whether a raised or normal ferritin level (from its function as an acute phase reactant in acute infections) is concealing what would otherwise have been a low ferritin level. Individuals with infection are likely to have falsely elevated serum ferritin concentrations[9] and therefore Heath (2001) excluded subjects with an elevated CRP from their study. However, there is still debate about whether acute infection affects the identification of iron deficiency [10].

1.1.2 Prevalence of iron deficiency

The Australian national dietary survey of schoolchildren (1985) found that whilst iron intake was adequate in young children, amongst 15 year old adolescent females the prevalence of iron deficiency was 9.2%[11]. Prevalence rates for iron deficiency (based on serum ferritin levels) in females aged 15-49 in Europe, North America and New Zealand ranged from 6-29%, with a median rate of 10%[12-20]. Rates of iron deficiency anaemia were lower and ranged from 1.5% to 11.5%[12, 13, 21]. These studies were performed in a variety of settings amongst children, adolescents and adults, and a variety of socioeconomic and racial groups. To our knowledge, only one previous study has specifically investigated iron status in a population of students at a university [22]. This study found a prevalence of iron deficiency of 7.2%, and iron deficiency anaemia of 4.5% in female

university students in Perth, Western Australia. In this same population the prevalence of low iron stores (Ferritin) was 19.8%[22].

1.1.3 Factors affecting iron stores in adolescence

The increased physical growth rate in adolescence brings with it heightened nutritional needs[23]. During adolescence, overall iron requirements increase in association with the timing and size of the growth spurt, as well as sexual maturation and the onset of menses[1]. In adolescent females, duration and intensity of menstruation are associated with decreased iron stores. Menstrual periods that last for longer than 5 days, and a woman's personal assessment of strong bleeding intensity are associated with decreased ferritin stores[9, 15].

Behaviour of adolescents also contributes to iron status. Blood donation can affect iron status by depleting iron stores. This effect is likely to be temporary, unless repeated blood donation occurs[9, 15]. Regular strenuous exercise is also associated with iron deficiency[20, 24].

Some behaviours are protective against iron deficiency. Taking the oral contraceptive pill typically reduces the length and intensity of menstrual blood loss, thereby protecting against iron loss[9, 15]. Consumption of any amount of alcohol also reduces the risk of iron deficiency anaemia[18, 25].

1.1.4 Dietary behaviour of adolescents and effect on iron levels

Dietary behaviour of adolescents affects iron levels, as the dietary patterns of adolescents may be associated with poor nutrient intake.

Adolescence is characterised by significant changes in lifestyle and eating behaviours[23]. Eating patterns highlight the transition of adolescence[26]. The ten characteristics of adolescent food habits are described as: missing meals, snacking, consumption of "fast" food, unconventional meals, alcohol consumption, soft drinks, specific likes and dislikes, high energy intake, low nutrients, and dieting[27, 28]. In addition to this, external and internal factors influence food behaviour such as: peers, nutrition knowledge and beliefs from family and culture, and mass media[26].

Adolescents' general knowledge of nutrition has been found to be inadequate[29]. Poor food selection patterns may be the cause of a diet inadequate of iron [24]. American high school students failed to achieve even half of the US Department of Agriculture food pyramid guide recommendations for healthy eating[23]. In the most recent national nutrition survey in Australia (1995), almost one third of adolescent females did not eat enough iron-rich foods to meet the estimated average requirement[30].

Dietary restraint or "dieting" may also contribute to low nutrient intake. Dieting is common amongst adolescents, in whom there may be body dissatisfaction and a perception of being overweight[31]. Breakfast is the most commonly missed meal amongst adolescents, with one in five adolescent females skipping breakfast, often due to a desire to lose weight[28].

Body mass index (BMI) outside the normal range may also be associated with low iron stores, with both low BMI and obesity being associated with iron deficiency[9, 32, 33]. The prevalence of iron deficiency increases with increasing BMI in both children and adolescents[32, 33]. This may be due to an intake of iron that is insufficient relative to an enlarged body mass, or it may be due to repeated restrictive dieting[32]. Given the burgeoning prevalence of overweight and obesity in our population, this is an increasing contributor to the prevalence of iron deficiency[33].

Low BMI (<20) is a risk factor for iron deficiency, independent of dietary intake[9]. However, the extremely low BMI seen in anorexia nervosa does not have the same association, with iron deficiency being uncommon in adolescent females with anorexia nervosa[34].
This may be due to a reduction in iron loss from secondary amenorrhoea, and also a contraction of circulating blood volume, whereby the iron from the red blood cells broken down in this process increases ferritin stores[34]. One percent of females in the second and third decades of life will suffer from anorexia nervosa, 5-6% from bulimia, and up to 20-25% report having elements of eating disorders[35].

1.1.5 Vegetarianism

The prevalence of vegetarianism was found to be 12% amongst school aged adolescents in South Australia, with 2.5% classifying themselves as 'full' vegetarian, and 10% as 'semi' vegetarian[36]. Similarly, amongst school aged adolescents in the USA, a prevalence of vegetarianism of 6% has been reported[37].

Reasons for adopting a vegetarian diet include concern for the environment and animal welfare[36, 38]. Another reason for eating a vegetarian diet is the belief that being vegetarian is healthier. This belief is supported by the Oxford Vegetarian Study, in which all cause mortality in vegetarians was half that of the UK population[39].

However, amongst teenagers, eating a meat free diet is not necessarily associated with health[40]. Vegetarians in this age group are more likely to be female, dissatisfied with their body image, with a greater prevalence of extreme weight loss behaviours such as intentional vomiting and laxative use[36, 37, 41]. There is a possible developmental link between teenage vegetarianism and eating disorders, which may be part of female adolescent identity development[36]. Vegetarianism may be adopted around the time of menarche, and a dislike of blood in meat may reflect a difficulty coping with the menarche and the transition into adulthood[40].

In order to avoid poor nutritional consequences of vegetarianism, vegetarians are advised to eat plant foods that are rich in non haem iron sources and low in inhibiting substances that decrease the absorption of non heme iron[3, 42].

1.1.6 Effects of iron deficiency on academic capacity and physical health

Iron deficiency is related to a decrease in general health and well-being, which can be both physical and mental[43]. Exercise capacity and endurance is impaired by iron deficiency[2, 44, 45]. Deficiencies in iron are associated with poor immune function and decreased work performance, which can manifest as increased susceptibility to infection, and fatigue[1, 46].

Iron deficiency can also impair cognitive function, with concentration and short term memory being the functions most likely to be affected[43]. Iron deficiency (with and without anaemia) has been shown to affect cognition, with iron deficient children achieving lower maths scores than their iron replete counterparts[13]. Giving supplemental iron to girls with non-anaemic iron deficiency has been shown to improve their verbal learning and memory[17].

1.2 Iron considerations in the University of New England student population

In 2002, a series of students with iron deficiency were seen at the University of New England Medical Centre. These students had a low meat intake, and also a belief that all that was needed to be healthy was to subtract most meat from the diet. There were a variety of other reasons for having a low iron intake. Many students had not previously chosen all their meals, prepared them, or had to balance their food budget themselves.

An initial chart review of 500 sequential patients (39% male, 61% female) seen at UNEMC revealed 10 students with iron deficiency, of whom 2 had associated anaemia. Half of these students reported tiredness as a symptom. Additional common symptoms in these 10 patients included weight loss, depression, anxiety and abdominal symptoms. Six of the students were concerned about their diet. Thirty three of these 500 patients had presented with tiredness, and 4 of these were found to be iron deficient.

The chart review raised several questions about the prevalence and presentation of iron deficiency amongst students seen at the UNEMC. It was anticipated that this prospective study would help to define the proportion of female students having a low iron level in the medical centre's student population, and provide a baseline for nutritional and iron replacement intervention with potential positive impact on students' current and lifelong health.

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2 Project Objectives

2.1 Primary Objectives

To obtain baseline data of iron status in this population of young women:

2.1.1 To determine the proportion of female students attending the University of New England Medical Centre who have risk factors for iron deficiency on the basis of their responses to a questionnaire.

2.1.2 To determine the prevalence of iron deficiency amongst those students who report risk factors in the questionnaire.

2.2 Secondary Objectives

2.2.1 To determine the relationship between the potential indicators of iron deficiency from the questionnaire and the actual pathology results.

2.2.2 To gain an understanding of the eating behaviours of this population and age group

3 Methodology

3.1 Methodology

Ethics approval for this study was obtained through the University of New England Human Research Ethics Committee (HE 06/070).

3.1.1 Dietary Questionnaire

Potential participants were initially approached when they came to see a doctor at the University of New England Medical Centre for their usual medical care. The initial approach was by the Medical Centre Registered Nurse, who asked the student whether they would be interested in taking part in the Project. If they were interested, she gave them an Information Sheet and a Consent Form to sign. The student then completed the Diet Questionnaire while they were waiting to see the doctor. (See Appendix Section 9.1.1 – 9.1.4 for information sheet, consent forms and questionnaires given to participants. The Diet Questionnaire was adapted from that described by Perry (2001)[37].

The completed Diet Questionnaire was reviewed by the doctor after attending to the student's presenting clinical complaint(s). If there was an indication from the four key questions in the questionnaire of possible iron deficiency (see below), the doctor recommended that full blood count and iron studies be included in investigations requested.

The four key questions chosen as indicators of possible iron deficiency were:

- Red meat was not eaten or eaten twice or less a week
- Menstrual loss was heavy (self rated)
- There was a previous history of iron deficiency
- The student or others considered she had current symptoms of iron deficiency. Such symptoms included tiredness, lack of energy, dizziness, frequent infections or pallor.

If the student responded positively to one or more of these, the doctor recommended that blood be taken for a full blood count and iron studies. If the student agreed to this they were given a second consent form to sign for drawing of the blood sample. The participant was directed to attend the Pathology New England Laboratory at the Armidale Rural Referral Hospital, Rusden Street, Armidale to have this performed. In addition to this, the student's height and weight were measured, and Body Mass Index (BMI) calculated.

3.1.2 Laboratory Analysis

Blood tests, including full blood count (haemoglobin, red cell indices, white cell count and platelets), and iron studies (serum iron, transferring, transferring saturation and ferritin levels) were recommended to respondents who were assessed to have risk indicators for iron deficiency.

Pathology testing was carried out at the Pathology New England (PNE) NATA accredited laboratories in Tamworth and Armidale. Non fasting specimens were collected by PNE staff.

The Tamworth Laboratory carried out testing for Serum Iron using a DXC 600 standard colourimetric method. Transferrin was also analysed on a Beckman Coulter DXC600 using an Immunoturbidometric method. Transferrin Saturation was a calculated result. Serum Ferritin levels were performed using a Beckman Coulter DXI800 by a Chemiluminescence technique

The Armidale Laboratory of Pathology New England carried out Full Blood Count testing on its Beckman Coulter Haem X analyser.

Eight patients presented to the other local pathology provider owned by Symbion. Ferritin results in these 8 patients were tested using a Roche Immunoturbidometric assay at 552 nanometres.

Data was analysed both with and without the inclusion of these additional 8 patients.

3.1.3 Data Analysis

Data was entered into Microsoft excel (version 2003) and imported into SPSS/Win (version 13.0). Some variables were coded using a numerical code (e.g. 1= no, 2= yes) e.g. Frequency of red meat intake, How do you rate your menstrual loss. Descriptive analysis was conducted and frequency tables were produced to obtain a descriptive profile of the data. Univariate analyses were undertaken on the data to explore the profile of the indicators of iron deficiency with Ferritin levels. Following on from these analyses, an attempt was made to identify if there were any associations between the indicators of iron deficiency and Ferritin using inferential/bivariate analysis. The hypothesis was tested using one way analysis of variance (ANOVA).

3.1.4 Reference Ranges

Normal reference ranges for the two laboratories differed (Table 1).

Table 1- Normal reference ranges for PNE and Symbion

Blood test	PNE reference range	Symbion reference range
Haemoglobin (Hb) g/L	115-165	115-165
MCV fL	80-100	79-99
Serum iron µmol/L	10-27	10-30
Ferritin µg/L	20-150	15-165

We used the individual laboratory reference ranges for each sample, and calculated results separately. When combining overall results, they were done using cutoffs from the separate reference ranges. Additionally, we calculated ferritin samples from PNE using a lower limit of 15µg/L to see if this made a difference to our prevalence.

4 Results and Discussion

4.1 Results

4.1.1 Descriptive data

Three hundred and sixty participants answered the questionnaire, of which 2 were excluded because of invalid responses/ missing data, leaving a sample size of 358. Of these, 219 respondents (61%) were considered to have risk factors for iron deficiency, and were advised to have blood tests on this basis, for which they gave consent.

One hundred and sixty five participants (46%) actually had blood studies done either at the pathology laboratory services attached to the Armidale Rural Referral Hospital (Pathology New England) (n=158) or at the private laboratory run by Symbion (n=7). Most of the blood tests (146/165) were done within 3 months of the clinic visit. Fifty four respondents who consented to blood tests did not proceed to having blood drawn, despite having risk factors for iron deficiency.

The mean age was 20.3 (SD, 2.7) years (Figure 1). Although the age range showed wide variation (18-41 years), 67% (n=240) were aged 20 years or below and 96% of the sample was aged 25

years or younger. It is of interest that 89% of the female students on campus (1522/ 1709) are 24 or less than 24 years of age.

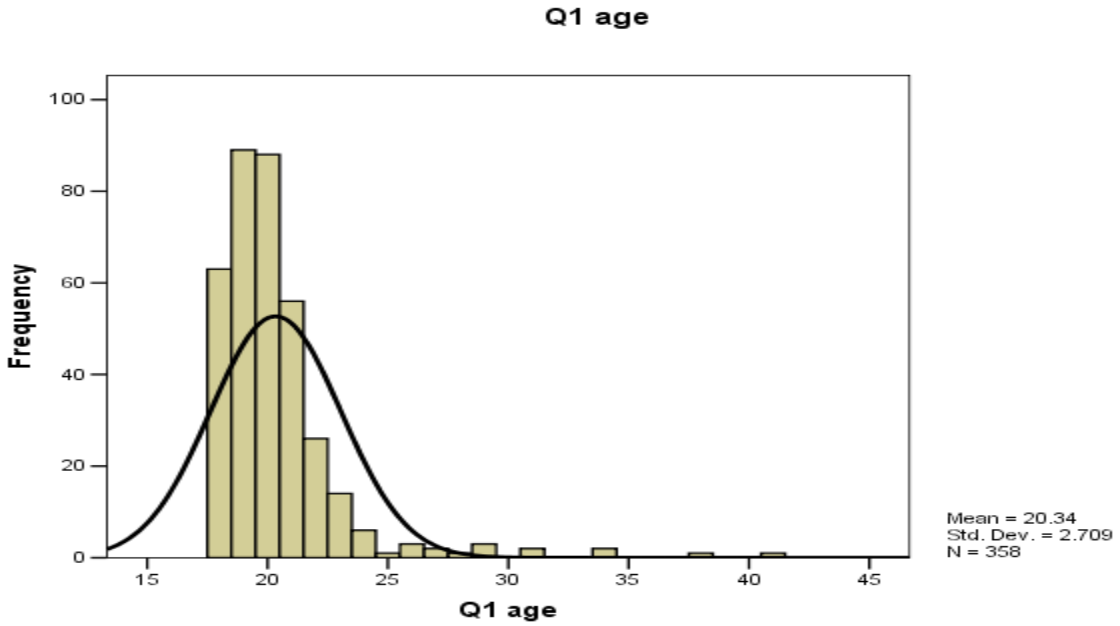

Figure 1: Age distribution of study sample (N=358)

Only 0.6% of the participants (2/358) were indigenous, while overseas students comprised 1.7% of the sample with a majority of the participants reporting their background as non-indigenous (95.3%). Nearly two-thirds of the sample lived in university accommodation, 59.2% (212) lived in fully catered colleges, while 9% had a self-catering arrangement. 31.8% lived in town accommodation and 7.% in self catered university flats. All were female.

Sixteen percent of participants reported ongoing illness, with the major categories being asthma, musculoskeletal, gastrointestinal and mental health problems. Twenty four percent of participants regularly used analgesics and anti inflammatory medications. Acute infection in the past 4 weeks was reported by 23% of respondents.

Fifteen percent of participants had donated blood in the last 6 months. The majority of participants (60.3%) exercised for more than 2 hours in a regular week, and 3.6% took part in long distance sport.

Two thirds of the cohort had their weight and height measured. Of these, half were in the healthy range for BMI (20-25 kg/m^2). Thirteen percent (32/240) had a low BMI (<20 kg/m^2), and the remainder were overweight (25%) or obese (12%), (range >25-30 kg/m^2 and >30 kg/m^2 respectively). Mean BMI was 24.3 (Figure 2).

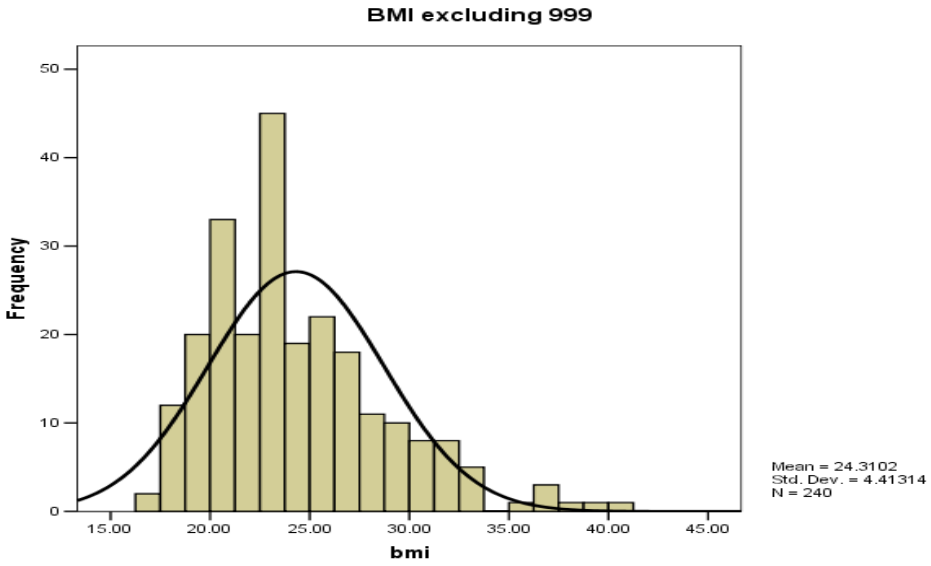

Figure 2: BMI distribution of study sample (n=240)

4.1.2 Risk factors for iron deficiency

Affirmative responses to four questions were used to flag for potential iron deficiency :

- Consumption of red meat less than 3 times a week
- Self-reported heavy menstrual blood loss
- A previous diagnosis of iron deficiency by a doctor
- Self-reported 'yes' response to question on have you considered that you could be iron deficient

Results from the questionnaire revealed that 8.4% (29) did not eat red meat at all, whilst 40.2% (144) ate red meat twice a week or less. Of the other risk indicators 11.5% (41) self-rated menstrual loss as heavy, 26% (93) had previously been told by a doctor that they were iron deficient, and 37.4% (134) considered that they could be iron deficient. (Table 2)

Table 2- Risk Indicators for low iron

1. Do you eat red meat	Number	%
No	30	8.4
Yes	328	91.6
If you eat red meat how often do you eat it?		
Not applicable	29	8.1
At least 3 times per week	185	51.7
Twice a week or less	144	40.2

2. How do you rate your menstrual loss		
Low	79	22.1
Medium	236	65.9
Heavy	41	11.5
Not applicable	2	.6
3. Has the doctor told you that you are deficient in iron		
No	265	74.0
Yes	93	26.0
4. **Have you considered that you could be iron deficient**		
No	223	62.3
Yes	134	37.4
No response	1	.3

An overwhelming majority of participants (91.6%, n=328) reported eating red meat, but only half of the participants ate red meat at the recommended rate of at least 3 times per week. Of those who ate red meat less than twice a week, most consumed other sources of protein (fish 33%, chicken 45%, pork 18%) and consumption of dairy products (44%), eggs (38%) and legumes (24%).

Self rated menstrual loss was noted to be high by 11.5% of our study participants, and moderate by 65.4%. 66% were taking the oral contraceptive pill.

Patients who had a previous diagnosis of iron deficiency were also asked if they had taken a course of iron tablets in the past. The majority of these patients had taken iron (77%, 72/93), which is 20% of the total cohort.

More than one third of the total study sample (37%) responded ‘yes’ to the question ‘have they considered they could be iron deficient’. Symptoms leading to thinking this were: tiredness (27%), lack of energy (22%), dizziness (13%), frequent infections (6%), pallor (4%), or other concerns (10%). Interestingly however, only 8.3% (n=30) respondents had presenting symptoms suggesting possible anaemia at the time of the UNEMC visit.

4.1.3 Prevalence of iron deficiency

One patient was found to have iron deficiency anaemia (Hb 111, MCV 74, ferritin 3), and two patients had a haemoglobin at the lower limit of normal (115g/L for both laboratories). Each of these patients had low iron stores (ferritin was 10 and 12 µg/L respectively). Twenty eight patients (7.8%) had serum iron below the reference range (<10µmol/L for both laboratories).

One hundred and fifty eight patients had ferritin measured at the PNE laboratory. Two outliers which were more than 3 standard deviations from the mean were excluded from the analysis, and the remaining 156 samples were analysed.

Mean ferritin level (and 95% confidence interval) for the sample overall was 39.2 µg/L (34.7-43.8), with a standard deviation of 28.7. The median ferritin was 30.2 µg/L, with a range from 3 to 142 µg/L (Figure 3).

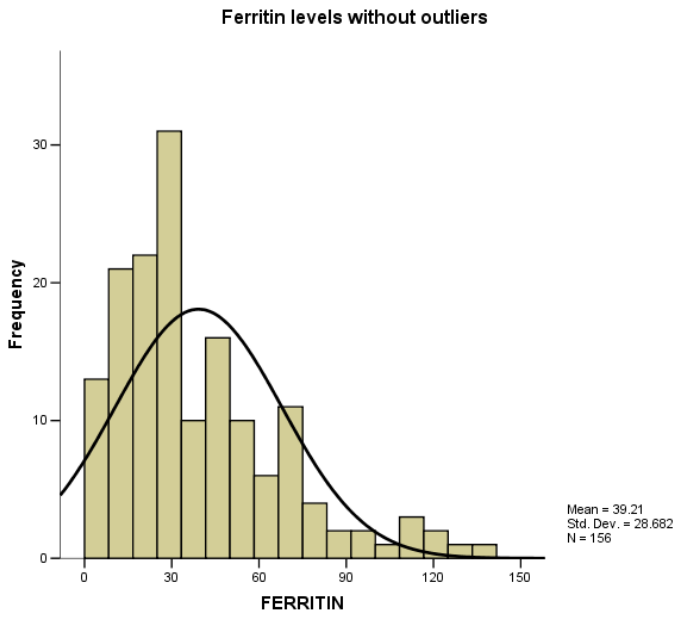

Figure 3- Ferritin levels – Pathology New England

Ferritin was defined according to the PNE reference range of 20-150µg/L. Therefore the frequency of iron deficiency using this lower limit of normal was 26.3% of the sample tested (41/156), which was 11.4% of the overall study population. If we describe iron deficiency using a cutoff value of 15, then 17.1% of those tested were iron deficient, or 7.5% of the total study participants. (Table 3)

Table 3- FERRITIN Revised 2 without outliers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 15	27	17.3	17.3	17.3
	15-19	14	9.0	9.0	26.3
	20-165	115	73.7	73.7	100.0
	Total	156	100.0	100.0	

Symbion results

The mean ferritin level of the 7 participants whose blood samples were analysed by Symbion laboratories was 49.3µg/L (Figure 4). The range in this sample was from 12 to 149 µg/L, with 2 of the 7 ferritin levels meeting the criteria for iron deficiency using this laboratory's reference range of <15µg/L.

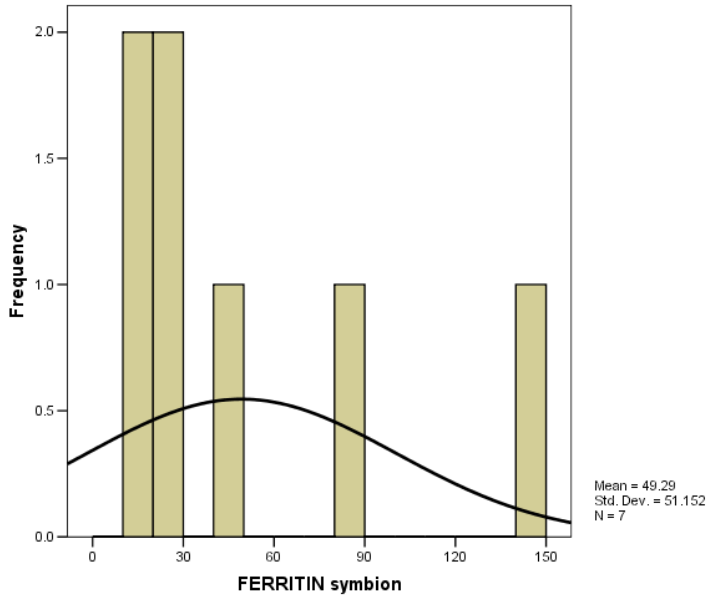

Figure 4- Ferritin levels- Symbion laboratory

Combining results from both laboratories, using their individual reference ranges, gives an overall prevalence of iron deficiency of 11.9% (43/360).

4.1.4 Indicators of iron deficiency

We examined the relationship between responses to the 4 iron deficiency indicator questions with ferritin levels (Table 4). We did not find that any of the questions were associated with low ferritin levels. Those who did not eat red meat appeared to have a lower mean ferritin than red meat eaters (28.3 vs 40.5), but this was not statistically significant. Patients with heavy menstrual loss had a lower mean ferritin (32.2µg/L p=0.034), but clinically this was still in the normal range. Also, patients who thought they might be iron deficient had a lower mean ferritin than those who didn't (40.6µg/L p=0.016), but they were still iron replete at this level.

Table 4- Indicators of iron deficiency and mean Ferritin levels- PNE (excluding outliers)

Indicators of iron deficiency		Mean Ferritin levels [SD]	F (df),p.value
Q5.Eat red meat	137	40.5 [2.5]	(1, 154)=2.11, p.= 0.148
Q6 No red meat	18	28.3 [16.8]	
Q6 Twice a week or less	89	39.4 [26.8]	(2, 153)=1.70, p.= 0.186
Q17a. Heavy Menstrual loss	21	32.2 [26.2]	(3, 152)=2.96, p.=0.034
Q18 Dr diagnosis	57	35.6 [32.5]	(1, 154)=0.001, p.0.973
Q20 Considered iron deficient	78	40.6 [30.8]	(2, 153)=427, p.0.016

Comparison of the indicators of iron deficiency from our questionnaire to ferritin levels in the group from Symbion was not possible due to such a small sample size.

4.1.5 Eating behaviours of this population

Low or non-meat eating (51%):
The respondents who did not eat meat, or ate meat less than 3 times per week, were asked how long they had been a low meat eater or vegetarian. Over half of the group (93/175) reported the duration to be more than two years. There were a range of reasons provided by the respondents, but for the purposes of this report the important ones include: meat provided is not appealing (n=83), not liking the taste of meat (n=61), to save money (n=33), wanting a healthier diet (n=28), study limitations on purchasing and cooking (n=28) and insufficient refrigerator space (n=13). There were very few affirmative responses to other possible options listed such as: I do not want to kill animals; religious reasons; to lose weight; or to avoid gaining weight .

Eating disorders:
In this study a number of questionnaire responses indicated the possibility of an eating disorder. :

- 12.6% indicated that they weighed themselves more often than once a week
- 3.6% said they had been told by a doctor that they have an eating disorder
- 2.2% said that they had tried to control their weight by vomiting
- 1.4% said they had tried to control their weight by taking laxatives
- 6.4% had tried to control their weight by taking slimming tablets

Concern about being overweight was also indicated by the following responses:

- 34.1% had tried to control their weight by exercise
- 33.5% by dieting
- 13.7% by skipping meals
- 80.7% by eating a healthy diet
- 7.5% by smoking

4.2 Discussion

Truswell (1985), emphasised that within a few years of the transitional stage of adolescence the young person usually gets married, works out a compromise set of food habits with the spouse or partner, and settles down to re-establish the eating behaviour of a new family. “It is here, in preparing and starting marriage that nutrition education should probably focus more.” Poor eating pattern formation can lead to future health problems[47].

It may be that there are similar healthful and problem outcomes associated with nutritional patterns adopted during university student life. In any event, the time at university when students may for the first time be taking responsibility for what they eat, is an important personal educational opportunity.

4.2.1 Prevalence of iron deficiency

The prevalence of iron deficiency in our study was 11.9% (11.4% for the Pathology New England Laboratory which has a cut off level for ferritin of 20µg/L, and 0.5% for the Symbion Laboratory, cut off 15 µg/L). Our study was cross sectional . The majority of its participants were non indigenous and were not from overseas. Our results were comparable to those found in our literature review:

(1) The very large 1988-1994, 24.894 National Health and Nutrition Survey (NHANES) USA study further analysed for the adolescents and young adults[13, 16] ;
- 700 16-19 year old females
- 4495 20-49 year old females

(2) The Dunedin NZ longitudinal study[21]; 371 females aged 21

(3) The mixed racial (Pacific Islanders, Asians, Europeans and Maoris) and socioeconomic Auckland study NZ [12]. Median age 16, range 14 - 21 years, 896 females

(4) 142 Australian 15 year old females in The National Dietary Survey of Schoolchildren (1985) [11].

In each study, as would be expected, the prevalence of iron deficiency (low ferritin) was greater than that of iron deficient anaemia (iron deficiency plus low haemoglobin)

(1) Iron deficiency 11% both age groups, Iron deficiency anaemia 3% for 16-19 year olds, and 5% for 20-49 year olds
(2) Iron deficiency 6.7% females, iron deficiency anaemia 2.2% females (<12ng/mL)
(3) 18.3% iron deficient (range from Maori 29.6% to European 15.2%), anaemia 11.5%.
(4) 9.2% were iron deficient (cut off <12mg/L)

The Rangan1997 study of 255 female students from Curtin University Western Australia and Perth metropolitan secondary schools, is the most comparable to our own[22]. The students were aged 15 -30 years (mean age 20.7). Their results showed iron deficiency 7.2%, iron deficiency anaemia 4.5%, and low iron stores (SF<20µg/L 19.8%).

One major factor influencing our results was the proportion of patients who were recommended to have blood tests, and who did not get them done. Sixty one percent of the cohort (219 respondents) were considered to have risk factors for iron deficiency, but only 169 (47%) actually had blood studies done. If a higher proportion of those with risk factors had attended for blood tests, the reported prevalence of iron deficiency in our population may have been higher.

The choice of reference range was an important consideration. The Royal Collage of Pathologists Australasia (RCPA), and Australian Iron Advisory Panel recommends a lower limit of normal for ferritin of 15µg/L[48, 49]. However, they also point out that patients can still have very depleted iron stores with a serum ferritin in the 15-20µg/L range[48]. Our decision to define iron deficiency as serum ferritin <20µg/L was based on the equipment and reference range used by Pathology New England Laboratories, and also based on the fact that we did not want to miss any cases of iron deficiency in this population. When we recalculated the prevalence according to the cutoff recommended by the RCPA (<15µg/L), the prevalence was much lower at 7.5%. We make a call for a standardised means of measuring serum ferritin, and standardisation of reference ranges, in order to make comparisons between laboratories and other published studies more meaningful.

The influence of infection on ferritin levels was a strong factor in our thinking, given the high prevalence of intercurrent infection in the Medical Centre's population group. Symptoms of infection

on presentation were analysed from patient charts. Apart from what were considered to be relatively minor viral illnesses, 31 had infections ranging through pelvic inflammatory disease, pneumonia and pleurisy, axillary abscess, streptococcal pharyngitis, and severe genital herpes to severe acne. We found it difficult to grade the severity of the infections, or to correlate them with either the white cell count or the ferritin level. Students were also asked about ongoing illness, regular use of analgesics and anti inflammatory medications, and acute infection in the past 4 weeks from this perspective. ESR and CRP were not measured, but WCC was analysed. Eight students were found to have a white cell count above the upper limit of the normal range of 11,000. We found it difficult to make any conclusive comment regarding the influence of infection on the ferritin level in our study group, which other studies have found similarly[21].

4.2.2 Factors affecting iron stores in adolescence

Menstruation and oral contraceptive use

In the Heath (2001) New Zealand study of 384 women aged 18-40 (mean age 24), pads/tampons used and their absorbency were used to create blood loss units[9]. The oral contraceptive pill was used by 141 women (37%). The analysis indicated that the effect of the oral contraceptive pill was entirely explained by their effect on menstrual blood loss. Our study participants, 66% of whom were taking the oral contraceptive pill, rated their menstrual loss as high for 11.5%, and moderate for 65.4%. The apparent lack of amelioration of menstrual blood loss by the oral contraceptive pill could partly be explained by the 32.4% who were not taking it and the 20% who had been taking it for a year or less.

Blood donation

Leggett (1999) considered that the frequency of blood donation was the next most important factor influencing ferritin concentration after gender[50]. Blood was donated 3 or more times a year by 15.6% of their population. Although 15.4% in our study had donated blood in the last 6 months we did not ask about frequency of donation, or when the student had last donated blood. Heath (2001) has also discussed the likelihood of frequent or recent blood donation affecting ferritin levels and the importance of women who choose to donate blood having their iron stores monitored regularly, as well as their haemoglobin levels[9].

The regional Blood Bank checks haemoglobin at each donation, and is a source of referrals to our Medical Centre for investigation of low or declining haemoglobin levels. It was considered that the number who had donated blood in our study group could not be significantly correlated with ferritin levels.

Exercise

Leggett (1999) found no significant relationship between frequency of active exercise causing sweating and breathlessness and ferritin levels[50]. Although 60.3% in our study exercised for more than 2 hours in a regular week, and 3.6% took part in long distance sport, our questionnaire was not sufficiently detailed to make correlations with ferritin levels.

Alcohol intake

Although Leggett (1999) found daily ethanol intake to be the most important factor after blood donation influencing ferritin concentration in men, diet was the next most important factor in women[50]. Regular consumption of alcohol is common in the university student population, and it may be that this increased the ferritin levels of our study group, however we did not ask about alcohol intake in this study.

4.2.3 Dietary behaviour of adolescents and the effect on iron levels

Our questionnaire focussed on current reasons for not eating meat, or eating it less than 3 times a week, since this is the main reason for iron deficiency and iron deficiency anaemia,

In contrast to the literature, which indicates humanitarian, animal rights and environmental reasons for vegetarianism and low meat eating, our study participants gave a predominance of practical responses to do with the appearance of meat, enjoyment or otherwise of the taste, cost of purchase, time for preparation, study priorities, and refrigerator storage space.

In regard to the ten characteristics of adolescent dietary habits [27], relevant questionnaire responses were: 33.5% tried to control their weight by dieting; and 13.7% skipped meals. These have not been correlated with ferritin levels.

Although adolescents' general knowledge of nutrition was found by Worsley (1990) in New Zealand to be poor and patchy[29], nevertheless our participants responses to the following questions on a 3 point scale give grounds for optimism and probably for health promotion:

- 64% cared very much about eating healthy food
- 53% cared very much about controlling their weight
- 75% cared very much about being healthy

They believe that the type of food they eat

- Effects their health 96%
- How they look 86%
- Their weight 92%
- How well they do in sport 82%
- How well they do in studies 84%

While only 51% of our study participants ate adequate amounts of meat, only 11.9% had evidence of iron deficiency, and only one of 360 had iron deficiency anaemia. Low meat intake, along with high menstrual loss, recent blood donation and the increased iron requirement for growth increases the risk of iron deficiency [3]. Leggett (1990) reported that in their study the ferritin concentration was higher in non-vegetarians than vegetarians, but that most of their population ate meat on most or all days[50]. Our questionnaire was not designed to be an in-depth dietary questionnaire. These students may have been obtaining iron in their diet from wholegrain cereal and other sources. A follow-up study involving a full diet history in this population would be useful. This study provides a useful baseline to explore issues in dietary behaviour, and to develop effective health promotion messages regarding the importance of adequate nutrition for university students.

4.2.4 Limitations of the Study

The chief limitation of our study was follow-up of students for their subsequent blood tests. This limitation, and reasons for it were only realised as the study progressed. The short academic study time for each term was effectively only about a month from the beginning of term before students had to submit assignments and sit for exams. The first questionnaires were given to students from 1st September to 5th December 2006. It was not fully realised that they would be unlikely to travel into town (~2.5km and the laboratory is not on the direct route to the CBD) to have a blood test in the 2-4 week time when assignments were due before the 2 weeks of exams. They then usually return from our rural university to their home towns or cities as soon as possible to save on rent. Also, at the end of the year it was quite likely that they would be finishing at university and not returning. In addition, nursing and education students had practicums which also took them away from Armidale, often adjacent to exam times.

The prevalence of viral illnesses during the time of the study also had an inhibitory effect on students attending for blood tests. In addition, staff time was diverted to a considerable degree by the Commonwealth Cancer Vaccination Program which involved some 850 additional patient visits for the first vaccination in the concluding stages of the study.

The effects of the academic timetable were thought to be the chief reason for the difference between the 61% (219) who agreed to have blood tests and the 46% (165) actually had them. In the circumstances the almost total agreement to participate in the study (2 exceptions), the 61.2% who agreed to have blood studies, and even more, the 47.1% who actually had them were both an indicator of the students' altruism and good will, and an indicator of the effectiveness of our nursing and medical staff in communicating with them.

Phone call follow-up attempts in the 2007 academic year were considerable. Their chief value was ascertaining the priorities and pressures for the largely late adolescent and young adult students in terms of their study, social life and relationships, family and employment . In addition, phone numbers and addresses were prone to change which often made follow-up contact difficult.

Reasons for not agreeing to have blood tests, that is those who did not sign the second consent form 23% of those who had risk indicators) were similar to the reasons given for not having blood tests they had consented to, that is :

- Could not be ascertained - mobile busy on repeated occasions (? cut off because of expense of mobile rates), repeated messages left,
- Said would call in for new pathology request forms but did not
- Given new request form but still did not have blood test
- Letter sent with result but no reply
- Left Armidale (overseas, interstate, home town or city),
- Recent blood tests and did not want more
- Blood tests elsewhere more recently which did not include iron studies
- Didn't think I needed blood studies so decided against it,
- I don't like blood tests
- Fear of needles
- Panic attacks with needles
- Planned to wait until after the exams then found there was no time before leaving Armidale
- Lost request.
- Would like to have done it but too busy with assignments and work

- Intended to have tests several times
- Will do it next week (twice)
-

Many students are really reluctant and fearful to have blood tests, especially when there is no other reason to do so than to check their iron level, even when in the clinic setting they feel happy to agree.

5 Success in Achieving Objectives

5.1 Project Objectives

5.1.1 To determine the proportion of female students attending the University of New England Medical Centre who have risk factors for iron deficiency on the basis of their responses to a questionnaire.

Successful

Of 360 female students who attended the UNE Medical Centre over a 12 month period, 358 questionnaires were valid. 60% of the sample lived in College residences.

Of the four risk factors chosen:

- Red meat intake - 8.4% (29) ate no red meat
  40.4% (144) ate red meat twice a week or less
- Heavy menstrual loss -11.5%
- Past history of iron deficiency- 26% (93)
- Concern by individual or friends re possible iron deficiency 37.4% (134)

5.1.2 To determine the prevalence of iron deficiency amongst those students who report risk factors in the questionnaire.

Successful

Baseline data of iron status in this population of young women, showed a rate of iron deficiency of 11.9%, which is what we had expected from our literature review. The rate may have been higher if more students who had consented to have blood tests had had them.

5.2 Secondary Objectives

5.2.1 To determine the relationship between the potential indicators of iron deficiency from the questionnaire and the actual pathology results.

Partly successful

The relationship between the potential indicators of iron deficiency from our survey, and the actual pathology results has not been completely delineated. Many who had several indicators did not have iron deficiency. It is unknown whether, if we had been able to test a greater proportion of those who completed the initial questionnaire, the results would have been significantly different. If they had been, would they have had any functional significance? (Eskeland 1999).

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5.2.2 To gain an understanding of the eating behaviours of this population and age group

Successful

The study has been a worthwhile learning experience in understanding the eating behaviours in regard to meat of current Australian late adolescent and young adult female university students, especially in a rural residential setting where many of the students have some connection with the meat and livestock industry through their home backgrounds and/or their courses.

It has implications which will be of value to them individually, to the university residential system, to the practical outcomes of their university courses, and to their future families.

6 Impact on Meat and Livestock Industry – now & in five years time

6.1 Impact on Meat and Livestock Industry – now

This study provides some insight into the eating behaviour of young female students attending a rural university. In our sample 61% lived in College residences, 7% in self catering flats at the University and 31.8% in town accommodation.

Knowledge of the eating attitudes and practices of this population group provides an opportunity for informed health promotion, both of the student group, and of College and University administrative staff responsible for engaging external catering services. There is an opportunity to make meat dishes appealing, to consider the cost of meat for students and Colleges who are endeavouring to save money, to educate about and provide alternative healthy options, including fast snacks, and to have an impact on future educated mothers. Students at UNE will often also have employment in areas related to the meat industry.

It is believed that conducting this study has already raised awareness among the students of having iron deficiency related to inadequate meat in the diet, and to symptoms of tiredness and frequent infections. We now frequently have requests from students to have their iron levels checked for these reasons.

Likewise, raised awareness of these factors for this young population group on the part of the Meat and Livestock Industry will be to the mutual benefit of the Industry and these young people.

6.2 Impact on Meat and Livestock Industry – in five years time

This will depend on whether the findings of this study are absorbed and its recommendations implemented (See below)

7 Conclusions and Recommendations

7.1 Conclusions

Of a convenience sample of 360 (358 valid responses) female students with a mean age of 20.3 years who attended the University of New England Medical Centre over a 12 month period, and of whom ~ 60% lived in college residences on campus,

Objective 1
Risk factors for iron deficiency were as follows:

1 Low red meat intake

- ~8% did not eat red meat
- ~ 40% ate red meat twice a week or less
- The most frequent reasons for not eating red meat were :
  Meat provided is not appealing 23%.
  "I don't like the taste of meat" 17%
  To save money 9%
  "I want a healthier diet" 8%
  Study limits time to purchase/cook 8%

2 ~12 %self rated menstrual loss as heavy

3 ~ 26% had previously been told by a doctor that they were iron deficient

4 ~37% They or their friends considered that they could be iron deficient

The value of the risk factors chosen requires further research.

Objective 2
Prevalence of iron deficiency

The prevalence of iron deficiency in our study was 11.9% (11.4% for the Pathology New England Laboratory which has a cut off level for ferritin of 20µg/L, and 0.5% for the Symbion Laboratory, cut off 15 µg/L). Three patients had a haemoglobin at or below the lower limit of normal. Seventeen percent had a serum iron below the normal range.

Objective 3
Relationship between questionnaire indicators of iron deficiency and pathology results

The relationship between the potential indicators of iron deficiency from our survey, and the actual pathology results has not been completely delineated. Many who had several indicators did not have iron deficiency. It is unknown whether, if we had been able to test a greater proportion of

those who completed the initial questionnaire, the results would have been significantly different. If they had been, would they have had any functional significance? (Eskeland 1999).

Objective 4
Understanding of eating behaviours/ beliefs in regard to meat eating and in general

- 63% cared on a 3 point scale very much about eating healthy food
- 82-95% believed that the type of food they ate affected their health, appearance, weight, and achievements in sport and study.
- Behaviours/beliefs in regard to meat eating are discussed.

Main limitation

- Of those who were assessed as having risk factors for iron deficiency

  61% (219) gave written consent for blood tests but only

  47% (168) had blood investigations.
  The reasons for this difference are discussed.

7.2 Recommendations

1. Incentives to the residential colleges are recommended to encourage them to purchase and prepare less expensive but nutritious and appealing cuts of meat. (Currently a frequent comment from the students is that the meat on offer is “dead” .There is usually only one meat option each night which is determined in advance, and may not include red meat. Such students say that they catch up with their meat when they go home in the holidays.)

2. A culinary competition is recommended for students who live in town. As part of this promotion the students would include tasty, inexpensive and fast recipes which could be for individuals, couples or groups. The recipe book resulting would have international student input. As follow up they would be asked what long term effect this could have for their future cooking. MLA could promote a scholarship to address these and similar issues to include dietitians, education and rural science students and others as appropriate.

3. It is recommended that this study be a pilot for MLA to fund a definitive study. This would demonstrate an improvement or otherwise in the cognitive abilities of iron deficient students undertaking a variety of courses from psychology to mathematics, and including medical and nursing students who take supplementary iron. A postgraduate psychology student would administer the requisite cognitive tests before and after an appropriate course of supplemental iron without the constraints of a medical centre setting. Students who have been involved in this present study could be a starting point for an extension of the study. As shown by the study, most students are interested in being healthy and believe that healthy eating does affect their sporting and academic abilities.

4. It is recommended that MLA offer a scholarship to a student in the School of the Professions to demonstrate the significance of good iron intake to healthy student life.

Implications for further research

- This study contributes to knowledge of ferritin levels in this population group.
- Clearer establishment of risk factors is needed.
- Clearer guidelines for vegetarians in regard to iron intake and measurement of the effect of promotion of these guidelines is indicated
- Measurement of take away food impact on iron intake would be of interest in the adolescent/young adult age group.
- Exploration of comparative/combined study with Perth and Sydney groups

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6 Appendices

6.1 Appendix 1

Particpant Documentation:

9.1.1 Information Sheet

9.1.2 Consent Form for Dietary Questionnaire

9.1.3 Dietary Questionnaire

9.1.4 Consent Form for Blood sample

9.1.1

INFORMATION SHEET IRON STATUS PROJECT

Title: Screening of female student population having a low iron level who attend UNE Medical Centre.

1 Aims of Project:

(1) Establish the proportion of students attending the University of New England Medical Centre who indicate in their responses to a questionnaire a potential for low iron levels
(2) Establish the proportion of those with these indicators who also agree to having blood tests who are confirmed to have low iron levels.

2 Justification:

The current Australian Dietary Guidelines endorsed by the National Health and Medical Research Council state:' Eat foods containing iron. This is particularly important for girls, women, vegetarians and athletes'.

Many students attending the University Medical Centre belong to these groups. They also have a variety of reasons for having a low iron intake. Many have not previously chosen all their meals, prepared them, or had to balance their food budget themselves. Vegetarian men are at risk too.

While it is known that a low iron intake can affect cognitive (learning) and physical abilities in children, the effect of iron deficiency in young adults is less certain. This pilot study will help to define the prevalence (level) in the Medical Centre's student population and provide a baseline for nutritional and iron replacement intervention with potential positive impact on students' current and lifelong health.

3 Contact details :

Dr Suzanne Robertson **Dr Jane Watt** **Dr Michelle Guppy**

UNE Medical Centre UNE Medical Centre UNE Medical Centre
Tel 67732916 Fax 67733686 Tel 67732916 Fax 67733686 Tel 67732916 Fax 67733686

email srobert6@une.edu.au email jwatt6@une.edu.au email mguppy@nedgp.org.au

4 Risks are minimal. If a blood sample is indicated by responses to the Diet Questionnaire and iron studies are recommended as part of usual care by the doctor, and consented to by the student, all due precautions are taken by the laboratories concerned.

5 Length of time needed: the Diet Questionnaire takes about 10 minutes to complete. This time should be available in the Medical Centre Waiting Room.

6 Duration and costs of participation: This will be the time involved in a consultation ie, the Diet Questionnaire will be examined by the doctor at the end of the consultation for which the student came to the Medical Centre. If there is a need for iron studies from a blood sample it will be recommended. The student will be asked, if they are willing to have the blood test, if they would like to sign the consent form before going to the Pathology Laboratory.

As the blood sample will be requested if the Diet questionnaire indicates a need for it. **The cost of the test will be covered by the project.** The participant will attend the Pathology New England Laboratory at the Armidale & New England Hospital Rusden Street.

7 If iron deficiency is shown by the test results, the student will be contacted, seen and three months iron supplementation will be recommended, nutritional advice given, and repeat iron studies in 3 months will also be recommended.

8 You are free not to participate and also to withdraw consent and to discontinue participation at any time without it effecting your care at the Medical Centre.

9 Data will be, during and after analysis, stored in a locked filing cabinet in the Medical Centre, and will be destroyed after 7 years. Only results of the blood iron studies will remain in the medical file.

10 Data will be kept confidential within the medical file. All data used for presentation or possible publication will be de-identified. Students requesting feedback on the Project as a whole will be able to have this when the Project is completed, possibly by early next year.

You are welcome to ask any questions you wish about the Project. **In addition, although it is unlikely that this research will raise any upsetting issues, if it should, please speak to Dr Robertson, Dr Watt or Dr Guppy or the nurse on duty who will advise you about appropriate resources (Telephone 02 6773 2916)**

This project has been approved by the Human Research Ethics Committee of the University of New England (Approval No. ----). Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at the following address:

Research Services
University of New England
Armidale, NSW 2351
Telephone: (02) 6773 3449 Facsimile (02)6773 3543
Email: Ethics@metz.une.edu.au

9.1.2 UNE MC Letterhead

CONSENT FORM FOR DIETARY QUESTIONNAIRE

Title: Screening of female student population having a low iron level who attend UNE Medical Centre.

Responsible Person and Research Associates: Dr Suzanne Robertson, Dr Jane Watt, Dr Michelle Guppy, Libby Vidal and Tanya Alcorn, Registered Nurses. Tel: 6773 2916

I……being a person
Given Names Family name

18 years of age or older, have read the information explaining the study.

Any questions I have asked have been answered to my satisfaction.

I understand that I may **withdraw** from the project at any stage, and that withdrawal will not interfere with my care at the Medical Centre.

I agree to allow my Medical Centre file to be reviewed by the Responsible Person(s) and Research Associates, to enable baseline and progress documentation. I agree that research data gathered from the results of this study may be used for presentation and/or publication, provided that identifying data are not used.

Dated……day of……2006/7

Signature……

_____

I……..have explained the above to the
Investigator's full name

Signatory who stated that he/she understood the same.

Signature…… Date: …….

9.1.3 **DIET QUESTIONNAIRE**

Serial Number ☐☐☐

Date ☐☐ ☐☐ ☐☐ I D Initials ☐☐ Date of birth ☐☐ ☐☐ ☐☐
Day Month Year Day Month Year

Instructions Please tick or complete appropriate box

1 Age (years) ☐☐

2 Race Non indigenous ☐ Indigenous ☐ Overseas student ☐

3 Sex Male ☐ Female ☐

4 Residence (current)

Type	***Duration (months)***
(1) College – catering ☐	_____
(2) College - self catering ☐	_____
(3) University flat accommodation – self catering ☐	_____

6.1.1.1 (4) Accommodation in Town -

- **single** ☐ _____
- **couple** ☐ _____
- **group** ☐ _____
- **family** ☐ _____

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

5 Do you eat red meat (eg steak, mince, lamb)

(1) Yes ☐

(2) No ☐ ∏ [If No, go to Q 7]

6 If you eat red meat, how often do you eat it?

(1) At least 3 times a week ☐ ∏ [Go to Q 10]☐

*(2) Twice a week or less * ☐ → [Go to next question]

7

7 As a low red meat eater or a vegetarian, do you eat any of the following?

(1) Eggs ☐

(2) Dairy food (milk/cheese) ☐

(3) Chicken ☐

(4) Fish ☐

(5) Pork ☐

(6) Legumes (baked beans, lentils, chick peas, kidney beans etc) ☐

8 How long have you been a low meat eater or a vegetarian?

(1) More than two years ☐

(2) Two years or less ☐

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

9 What are your main reasons for eating a low meat or vegetarian diet?

(1) To lose weight ☐

(2) To keep from gaining weight ☐

(3) I want a healthier diet ☐

(4) To help the environment ☐

(5) Religious reasons ☐

(6) I do not want to kill animals ☐

(7) A household member is a vegetarian ☐

(8) I don't like the taste of meat ☐

(9) To save money ☐

(10) Meat provided is not appealing ☐

(11) Study limits time to purchase/cook ☐

(12) Insufficient refrigerator space ☐

10 How much do you care about the following

		Not at all	Somewhat	Very much
(1)	Eating healthy food	☐	☐	☐
(2)	Controlling your weight	☐	☐	☐
(3)	Being healthy	☐	☐	☐

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

11 Do you agree or disagree?

You can provide more than one response

			Agree	Disagree
7.1		The types of food I eat effect		
7.2	(1)	My health	□	□
7.3	(2)	How I look	□	□
7.4	(3)	My weight	□	□
7.5	(4)	How well I do in sports	□	□
7.6	(5)	How well I do in studies	□	□

12 In regard to your weight:

(1) Do you weigh yourself often?(more than once a week)Yes ☐ No ☐

(2) Has a doctor ever told you that you have an eating disorder?

Yes☐ No ☐

(3) In the last year have you tried to control your weight by

1 Vigorous exercise Yes☐ No ☐

2 Dieting Yes☐ No ☐

3 Skipping meals Yes☐ No ☐

4 Eating a healthy diet (increasing fruit & vegetables, reducing high fat foods, reducing sweet foods)

Yes☐ No ☐

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

12 (cont'd)

5 Smoking Yes☐No ☐

6 Vomiting Yes☐No ☐

7 Laxative use Yes☐No ☐

8 Taking slimming products Yes☐No ☐

8 13 In regard to your physical activity in a typical week, is it

(1) Greater than 2 hours Yes☐No ☐

(2) Two hours or less Yes☐No ☐

(3) Long distance sports Yes☐No ☐

14 Do you have any ongoing illness?

Yes☐No ☐

If Yes, please describe _____

_____

15 Have you donated blood in the last 6 months? Yes☐No ☐

16 Do you take analgesics or antiinflammatory medications regularly?
(For example, Panadol, Panadeine, Brufen, Naprosyn, Naprogesic)

Yes☐No ☐

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

17 For females

(a) How do you rate your menstrual loss?

- Low ☐
- Medium ☐
- *High * ☐

(b) Do you take the oral contraceptive pill?

Yes☐ No ☐

If Yes, number of years ☐☐

9

***18 Has a doctor previously told you that you are deficient in iron? ***

Yes☐ No☐

10

19If yes, have you taken a course of iron tablets?

Yes☐ No ☐

20 *Have you considered that you could currently be iron deficient? *

Yes☐ No ☐

If Yes, what symptoms have led you to think this? _____
(Specify which of persistent tiredness, lack of energy, dizziness, frequent infections, others being concerned about your pallor, or other reasons.)_____

Initials ☐☐

Date of Birth ☐☐ ☐☐ ☐☐

21 Are you concerned that you could be depressed?

Yes☐ No ☐

If Yes, please indicate your symptoms and indicate if you would like help

_____

_____

24 Have you had an acute viral, skin or other infection in the past 4 weeks?

Yes☐ No ☐

IF YOU ARE CONCERNED ABOUT ANY HEALTH ISSUES AND WOULD LIKE SOME HELP, OR REFERRAL TO OTHER RESOURCES, PLEASE TALK TO THE DOCTOR YOU WILL SEE.

For Doctor's use only

Is this person proceeding to blood testing? Yes☐ No ☐

Height cm ☐☐☐

Weight kg ☐☐☐

Waist cm ☐☐☐ BMI ☐☐

UNE MC Letterhead

11 CONSENT FORM FOR EXAMINATION & INVESTIGATION

Title: Screening of female student population having a low iron level who attend UNE Medical Centre.

12 Responsible Person: Dr Suzanne Robertson (02) 6773 2916

I……being a person
Given Names Family name

18 years of age or older, have read the information explaining the above study.

Any questions I have asked have been answered to my satisfaction.

I agree to being weighed, to having my height measured and having these and my BMI recorded, and to having a blood sample drawn for iron studies with due precautions, at the recommended laboratory (Pathology New England, Armidale & New England Hospital, Rusden Street). I understand that the cost of the haemoglobin, iron studies (and blood film if needed) are to be met by the project funds. If the blood sample shows an iron deficiency this will be recorded on my medical file. I understand that progress iron studies in three months will be recommended, should iron deficiency be found and iron supplementation advised.

I understand that I may **withdraw** from the project at any stage, and that withdrawal will not interfere with my care at the Medical Centre.

I agree to allow my Medical Centre file to be reviewed by the Responsible Person(s) and the Research Associates to enable baseline and progress documentation. I agree that research data gathered from the results of this study may be used for presentation and/or publication, provided that identifying data are not used.

Dated……day of……2006/2007

Signature……...

_____

I……..have explained the above to the
Investigator's full name

Signatory who stated that she understood the same.

Signature…… Date: …….