IMPACT OF IRON FORTIFIED FLOUR IN CHILD BEARING AGE (CBA) WOMEN IN FIJI 2010 REPORT

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Impact of Iron Fortified Flour in Child Bearing Age (CBA) Women in Fiji 2010 Report

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About the authors

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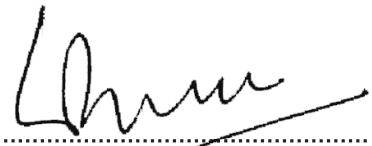
FOREWORD

The Ministry of Health began to address the problem of micronutrient deficiencies by implementing strategies nationally in the 50s. For example, iron supplementation for pregnant women at MCH clinics during first booking was one of the first programmes that dealt with anaemia. But despite this and other promotional activities, anaemia continued to increase.

In the late 1990s, Government sought assistance from International and Regional partner agencies such as UNICEF, WHO, Micronutrient Initiative (MI) to combat anaemia in Fiji and in particular women of child bearing age. This resulted in the development of legislation to fortify all locally milled flour in 2004 with internationally approved micronutrient standards. The legislation was gazetted in 2003.

The flour fortification programme involved government working with local flour millers in Fiji. This marked an important milestone in terms of public and private partnership to address health nationally.

This report provides the first systematic study of an assessment of the effect of the national flour fortification strategy to combat anaemia in Fiji. The results will enable the Ministry of Health to make informed decisions regarding evidence based policy development as well as the monitoring and evaluation of these policies in future.



Dr Neil Sharma
MINISTER FOR HEALTH

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ACRONYMS

BMI	––	Body Mass Index
CBA	––	Child Bearing Age
CRA	––	Community Rehabilitation Assistant
EA	––	Enumeration Area
IDA	––	Iron deficiency anaemia
MCH	––	Maternal Child Health
NFNC	––	National Food and Nutrition Centre
NNS	––	National Nutrition Survey
PPS	––	Population proportion to size
RDI	––	Recommended Dietary Intake
SD	––	Standard Deviation
UNICEF	––	United Children's Fund
USP	––	University of the South Pacific
WHO	––	World Health Organization

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Flour fortification has been successfully used as a public health strategy to control iron deficiency and anaemia in the developed as well as developing countries. For health and economic reasons, many developing countries that have used flour fortification are evaluating the strategy to determine its contribution to improve iron and anaemia status of specific population groups.

Fiji conducted an evaluation of its iron fortified flour strategy in 2010, five years after it was gazetted.

The survey populations were women of child bearing age (CBA) 15-45 yrs randomly selected and matched for age, ethnicity, and Enumeration Areas (EAs) with the 2004 NNS Micronutrient Survey. Based on the 2007 Fiji population census, a total of 870 CBA women were identified to be included in this study.

The main objectives of the 2010 study were two-fold: i) Assess the effectiveness of Fiji's flour fortification strategy and; ii) Evaluate the policy development processes.

Summary of findings

Sample description

A total of 869 CBA women (15-45yrs) were included in the final analysis (response rate of 99.9%). Of the 869 CBA women, 61.4% were iTaukeis, 37.4% were IndoFijians and 1.2% was 'Others'. Age-group wise, 13.2% were 15-<19yrs and 86.8% were 19-45yrs. Location wise, 42.8% lived in the Central division, 40% in the Western division, 13.2% in the Northern division and 3.5% lived in the Eastern division (maritime island). The majority (61.8%) completed secondary school and 18.9% completed tertiary education while 14.7% completed primary school. About a third, 36% had up to 2 children, 23.9% had 3-4 children while 8.2% had 5-6 children. Those with no children constituted 31.9%. Only 16.1% were earning at the time of the survey. Of these, the majority (31.7%) was in the 'elementary' category (house helpers etc); 21.6% were in the 'service' category, 17.3% were professional and 11.5% were clerical officers.

Knowledge of flour and fortification

The majority (90.4%) of CBA women surveyed in 2010 reported using or consuming 'normal' flour (i.e. white), 4.7% reported consuming both normal and whole meal while 4.7% did not know the type of flour they used at home. More iTaukeis (62.5%) than IndoFijians (36.4%) reported consuming 'normal' flour.

FMF brand was purchased by the majority (71.6%) compared to the 'PUNJAs' brand. Overall, 38.1% stated that price determined their choice of brand and 31% identified 'taste' as the main factor. Only 15% identified 'availability' as the factor. Relatively more iTaukeis (66.2%) identified 'availability' compared with 33.1% IndoFijians.

A large proportion of the study population (71.2%) did not read nutrition labels on food packages. Relatively more iTaukeis (67.4%) did not read labels compared with only 31.3% of IndoFijians.

Only 9% of the study population had heard about fortified flour while 91% had not. The majority of those who had not heard about fortified flour were iTaukeis (61%) compared to only 37.3% of IndoFijians.

Health information

A relatively small proportion of the 2010 study population (16.1%) had taken nutrient supplement in the six months prior to the survey. Slightly more IndoFijians (56.4%) than iTaukeis (42.1%) took nutrient supplement. Iron and folic acid tablets were the more common supplement taken. The majority (76.1%) reported taking supplement on the doctor's advice. More IndoFijians (69.7%) took supplement on their own initiative compare to iTaukeis (30%).

Nutritional status by BMI

The majority (45.5%) of the 15-<19yrs (n=77) were in the normal BMI (<+1SD). Relatively more iTaukeis (62%) than IndoFijians (11.5%) were in this category. Overall, 5.2% were in the severely wasted category (<-3SD), the majority (15.4%) were IndoFijians. Only 3.9% in this age group (15-<19yrs) were overweight (<=2SD). Ethnically, the proportions of those assessed as overweight were similar: 4% were iTaukeis and 3.8% were IndoFijians.

Just over half, 51.2%, of the 19-45yrs (n=792) age group were healthy (BMI 25.0) with similar proportions ethnically (48% iTaukeis and 48% IndoFijians). More IndoFijians were underweight (87.8%) compared with 12.2% iTaukeis while more iTaukeis (66.5%) were overweight compared with IndoFijians (31.9%). Relatively more iTaukeis (73.7%) were obese compared with IndoFijians (25.1%).

Impact of iron fortified flour

A comparison of the results of the 2004 micronutrient survey (before flour fortification) and

2010 study (after flour fortification was implemented nationally) showed relative positive changes (improvements) in the iron deficiency rates and anaemia. Given the timing and the changes observed, these might be regarded as 'good evidence'.

Overall, differences between the two years in the mean blood serum levels of the four main micronutrients examined were statistically significant (p=0.000) with positive shifts. The differences in mean serum ferritin (iron store), 51.70µg/L before and 76.70µg/L after, were statistically significant at p=0.000, an improvement of 25µg/L in 2010. Mean haemoglobin levels before and after were similar (12.20 g/dL and 12.42 g/dL respectively), and the differences were statistically significant (p=0.001), a 0.22g/dL improvement. Mean Hb distribution before and after showed that fewer women were at the lower end of the distribution curve while there was an increased 'bunching' around 12g/dL Hb. This suggests that more of the women surveyed had obtained the minimum Hb level per day. This is positive.

Results for folate showed a similar pattern. Mean serum folate level before legislation was 18.0nmol/L and 26.6nmol/L after, with differences statistically significant at p=0.000 - an improvement of 8.6nmol/L. There was also some improvement in mean zinc serum level of 1.65µmol/L (11.80µmol/L before flour fortification and 13.45µmol/L after fortification) with statistically significant differences (p=0.000) between the two studies.

Positive changes in deficiency rates were observed among women of child bearing age after fortified flour came into force. Serum ferritin deficiency (iron store depletion), was 22.9% before whereas deficiency rates was only 7.9% after; the differences between 2004 and 2010 were statistically significant (p=0.000) for all categories (overall, ethnic group, age group, and locations) except for the Eastern division (p=0.430). Anaemia (the end stage of iron depletion in the body) among CBA women before was 40.3% and 27.6% after fortified flour was implemented. The change was positive and statistically significantly (p=0.000).

Differences in folate deficiency before and after were statistically significant (p=0.000) for most groups except for the Central Division (p=0.080), Northern (p=0.062), and Eastern division (p=0.094). Differences in zinc deficiency rates (before and after fortified flour legislation came into force) were also positive and statistically significant (p=0.000) for all categories.

The positive trend shown could be related to the amount of flour and flour products consumed by the survey population between the two years. The differences in the average amounts consumed overall before (195.14 g/person/day) and after (246.01g/person/day) were statistically significant (p=0.000). With the exception of the northern division (p=0.158) and eastern (p=0.897), differences in the amount of flour consumed between the two years were statistically significant for other groups.

The contribution of flour and flour products to the total micronutrients in the diet of the study population between the two periods was statistically significant. The percent contribution of flour and flour products to specific micronutrients in the diet after flour fortification showed iron increased 2.9 times; zinc increased 2.5 times; thiamin increased 1.8 times; riboflavin increased 2.6 times; niacin increased 3.7 times; folate increased 11.3 times. These results showed improvements!

Green leafy vegetables (iron-rich food-source) contributed 5.05% to total iron in a day's diet in 2004 and showed a slight increase to 6.11% in 2010. In 2004, animal protein food (the best source of iron due to its bioavailability) contributed 22.37% iron to total iron in the day's diet but decreased to 15.12% in 2010. The differences between the two years were significant for both green leaves (p=0.013) and meat (p=0.052). The decrease in percent contribution of meat to total iron in the day's diet of the study population could possibly be attributed to the high cost of meat/fish/poultry. This decrease may impact on the absorption of iron from plant sources including that from fortified flour. However flour and flour products contributed the highest percent to total iron in the diet compared with the other two product groups.

Food fortification should not be seen as the only solution to the anaemia problem. It should form part of a multiple strategy approach that include iron supplementation, dietary diversification along with sanitation plus deworming programmes.

Flour fortification standard compliance

Laboratory analysis of flour samples purchased from supermarkets to establish the level of nutrients were conducted and the results compared with the standards for fortified wheat flour in Fiji. Using iron content as indicator of proper fortification, the analysis results showed the minimum standard was achieved for normal flour by one brand while the other reached around 91.66% of the minimum iron standard for the same type of flour.

Policy process evaluation

The evaluation highlighted the absence of a monitoring and evaluation plan as an integral part of the policy implementation (Snowdon, 2010). The policy nonetheless clearly demonstrated the potential of private and public sector partnership in addressing health problems nationally.

More details can be found in a separate report, "Legislation to mandate the supply of fortified flour in Fiji: Desktop Review of Policy development process" by Dr Wendy Snowdon.

Conclusion

In conclusion:

1) The data from the study showed that the prevalence of anaemia, iron, zinc & folate deficiencies were lower after the flour fortification programme was implemented nationally.
2) The differences observed in the rate of anaemia, iron, zinc and folate deficiencies between baseline (2004) and 2010 (after) were highly significant. The changes showed marked improvements with much lower deficiency rates after fortification was nationally implemented.
3) The differences in the proportion of CBA women with both iron and iron deficiency anaemia had been reduced by half in 2010 (14.9% in 2004 and only 7.5% in 2010), while the proportion of those deficient in four micronutrients was reduced by 42% (68% in 2004 to 28.1% in 2010).
4) Based on the results of our study, the national fortification of flour with iron (& other micronutrients) may have contributed to the improvement in the reduction of deficiency rates of micronutrients studied in particular iron and anaemia.
5) The results suggests that the fortified flour have contributed positively to the improvements in iron and micronutrient levels in the diet of CBA women in this study and a reduction in anaemia rates, as illustrated by the improved micronutrient levels in their blood. However, it is not possible to say with absolute confidence how much of the change is due to fortified flour as a result of the study design.

Although the efficacy of the strategy could not be properly evaluated due to the design adopted as a result of the national implementation of the flour fortification and the time lapse between the two periods (implementation and evaluation), it could be stated that fortified flour has had a positive impact on anaemia among child bearing age women in Fiji, based on the positive direction of change shown.

Recommendations

It is recommended that:

1. Since flour fortification is only one approach to address anaemia in Fiji, a concerted effort should be made to address the problem holistically by complementing flour fortification with other strategies such as practical dietary diversification, continuing the iron supplementation program and sanitation;
2. A rigorous effort is made to educate the communities about food choices for nutritious meals that are practical, accessible, relevant and culturally appropriate;
3. A practical intensive education programme is developed and implemented to educate the public about the importance of reading food labels before purchasing food products;
4. The Ministry of Health with flour millers develop a shared monitoring and evaluation system/plan to ensure legislation and standards compliance are adhered to by all stakeholders including importers;
5. That the Ministry of Health in partnership with the local Flour Millers use the results of this study to review the current fortificant standards and consider adopting relevant parts of the new WHO/FAO recommendations and in particular:
    a. Using either ferrous sulfate or fumarate compounds as fortificant if at all possible;
    b. Increasing zinc oxide to 40mg/kg;

1.0 THE CONTEXT

1.1 Introduction

Since 1950s, there has been recognition of micronutrient problems in Fiji as shown by a number of smaller nutrition surveys. Subsequent national surveys in 1981 and 1993 highlighted the problem nationally. The 1993 National Nutrition Survey (NNS) found anaemia in 40% of children under five year of age; 32% of adult women and 16% of men. Anaemia is a severe public health problem particularly in women and children. Attempts to address anaemia have been ongoing since the 1980s. Discussion of fortification and the establishment of an iron fortification taskforce began in the 1990s. The impetus was the global push for fortification (including flour), through regional meetings and an external consultant (Griffiths, 2003).

Iron fortification programmes have contributed to the reduction in iron deficiency anaemia in many developing countries (Le, Brouwer et al, 2006; Zimmermann et al, 2005; Baltussen et al, 2004; Hurrell et al, 2004).

Fortification was adopted by Fiji as a national strategy to control and prevent iron deficiency anaemia in the country. Fortification is the addition of one or more nutrients to a food, whether or not it is normally present in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups (Whittaker et al, 2001) and is one of the most cost-effective solutions globally to improve health (Johnson and Wesley, 2010; Sun et al 2007; Garcia-Casal and Layrisse, 2002; Hurrell, 1997). Fortification is an effective approach because it does not require dietary change in the population (Akhtar et al, 2008).

Flour was chosen in Fiji as the best vehicle for iron fortification because it is consumed by all ethnic groups daily (NNS 1993; Schoffelen, 1999). Fortification was gazetted on 14th November, 2003 (4) under the Trade Standards and Quality Control Decree 1992 (Appendix 2). Fortificants and standards included the micronutrient iron, folic acid, zinc, and B vitamins (thiamine, riboflavin & niacin). The addition to flour of zinc, riboflavin, thiamine and niacin was justified on the basis that that these are usually available in wholemeal flour, but not in white flour.

Full implementation began in 2005. Continuous monitoring of fortificant levels at the point of sale as proof of compliance and for safety levels should be an integral part of the programme.

1.2 Study rationale

1.2.1 Objectives of the study

The general objectives of the study were two-fold. Firstly to evaluate the effectiveness of flour fortification by assessing blood levels of ferritin and haemoglobin as well as the prevalence of anaemia and iron deficiency in CBA women, and secondly, to evaluate the policy developmental processes.

1.2.2 Specific objectives were to:

a) Assess the effectiveness of the Fiji flour fortification strategy:

i) Explore the impact of the iron and other micronutrient fortified flour on the Hb and iron status of Fiji women of child-bearing age.

ii) Assess the knowledge, awareness of and attitudes towards fortified flour of Fiji women of child-bearing age

iii) Explore daily consumption of flour, and flour products among different ethnic groups, residence (urban and rural) as well as consumption of other foods i.e. daily food consumption patterns and whether these positively affected Hb and iron level in women of child bearing age.

iv) Assess flour fortification standard compliance.

b) Evaluate the fortification policy developmental processes.

NOTE: The levels of ferritin and haemoglobin in the blood will be the core criteria for assessing the impact of fortified flour.

1.2.3 Questions to be answered

The study aimed to answer four major questions in relation to anaemia and iron deficiency:

- What has changed since the fortification programme began?
- How much change has occurred since the programme began?
- How and why did the change occur or not?
- How much of the change can be attributed to the flour fortification itself rather than to external factors. (In other words, the study needed to know if the fortified flour programme contributed to the observed effect or were there some other reasons).

2.0 Materials and Methods

The survey was designed as a cross-sectional study among non pregnant women of child bearing age in Fiji. It was reviewed and endorsed by the National Health Research Committee and approved by the National Research Ethics Committee. The 2004 NNS Micronutrient Survey of child bearing age women was used as baseline.

Study sites and population, and age group from which the participants selected were matched with the Fiji 2004 NNS Micronutrient Survey of women of child-bearing age (CBA). This was done to enable a 'before' and 'after' comparison. Only CBA women who were Fiji citizens, non-pregnant with no known illnesses were included.

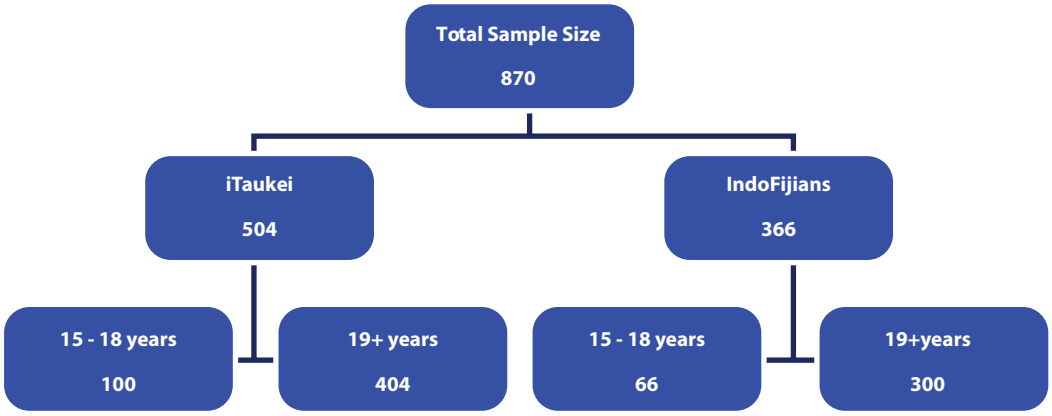
The sample size for this study was calculated by means of the OpenEpi software version 2.3 based on the 2007 population census as illustrated in Figure 1 below. A sample size of 870 participants was calculated with 35% expected prevalence of iron deficiency anaemia (IDA), a 13% allowance for dropout rate, an absolute precision of 5% with 95% confidence interval (CI), and a design effect of 2. The total sample for each population group is calculated by population proportion to size (PPS). The calculated sample size was designed to detect a 2mg difference in the mean Hb between the two surveys (2004 and 2010).

Women participants (870) were chosen from the list provided by the zone nurses in the respective 30 randomly selected EAs. The population of CBA women per EA was stratified by ethnicity and age group and then randomly selected using the PPS approach, to determine the sample size for each EA. The women were then selected according to ethnicity and age group required for each EA (Appendix 3). The lists of selected women for each EA were sent to the respective SDHS for the zone nurses to inform participants and obtain signed consent forms.

Consent forms for those under the age of 21 years had to be signed by their parents/guardians. Only women with signed consent took part in the study.

A 99.9% response rates was received

Figure 1: Sample population



Three fieldwork teams each consisted of 5 members: a team leader, weight-taker, height-measurer, interviewer (general questionnaire and 24hr food recall), and a laboratory technician to take blood sample.

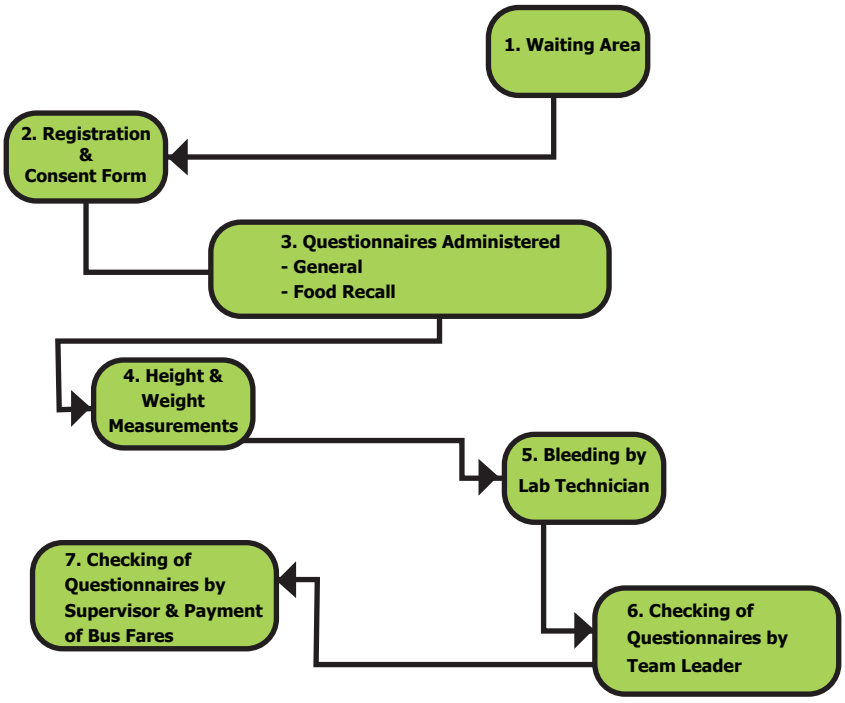
Each team was provided with a research package which consisted of:

1. Names and list of participants
2. Questionnaires (General questionnaire and 24hr Food recall with measurement aid)
3. Weighing scale (Seca 876) and standard weight
4. Stadiometer (Seca 217)
5. Laboratory-ware for bleeding and storage of blood.

The general questionnaire (Appendix 4) was used in the face to face interview; anthropometric measurements (weight and height) were taken using standard protocol; 24hr Food Recall questionnaires (Appendix 5) was used to establish nutrient intake. Blood samples were taken for biochemical analysis to determine levels of selected micronutrients.
In addition to the above, fortified flour analysis for levels of fortificants at point of sale were also undertaken by Hills Laboratory, New Zealand and validated by the USP Institute of Applied Science Laboratory, an Internationally Certified Laboratory. A desk review of the processes of the development of fortified flour legislation was also undertaken.

A pilot survey was conducted to test the tools and protocols. The questionnaires and survey processes were refined accordingly. Training of the survey teams covering all aspects of data collection was conducted two days before data collection.
The process of data collection in the field is illustrated in Figure 2.

Figure 2: Data Collection Process



Blood samples were taken from participants by trained laboratory technicians and stored according to standard protocols.

2.1 Data management and analysis

Completed questionnaires were checked on site by the team supervisor and signed off as part of data quality control. The completed questionnaires were re-checked at the office, and the food recall coded before data entry using EpiData software version 3.1.

Statistical analysis was conducted using the SPSS version 12 software. EpiInfo version 3.3.2 was used to obtain frequencies, mean, confidence interval as well as significant tests (Independent sample t-test and One-way Anova) for comparison of appropriate data. In all statistical tests, results were considered significant if $p \leq 0.05$.

Diet recall was analyzed for nutrient contents using FoodWorks, a computerized programme which enables the daily intake of food to be analyzed and SPSS for detailed analysis of variables.

The categories 'overall', 'ethnicity', 'age group' and 'division' were used for analysis purposes.

The two age groups '<19yrs' and '19+ yrs' were used to enable the calculations of the Recommended Dietary Intake (RDI). In this report the two age groups 15-18yrs or <19yrs will be used interchangeably while 19-45yrs or 19+ yrs will also be used interchangeably.

2.2 Definitions used and cut-offs

Assessment criteria applied are shown in the tables below
(Table 2.2.1; Table 2.2.2; and Table 2.2.3)

Table 2.2.1
Laboratory tests used and range in values

Variable	Analytic Test or Method	Normal Range Values (for women)	References
Haemoglobin	Sysmex Xs 800i	115-154 g/L	Tropichealth Laboratories
Ferritin	Modular E170 Electro-chemiluminescence	20 - 450 µg/L	Tropichealth Laboratories
Folate	E170 Electro-chemiluminescence	9.0 - 45 nmol/L	Tropichealth Laboratories
Zinc	Atomic Absorption Spectrophotometry	10 – 20 µmol/L	Symbion Laverty Pathology- Sydney

Table 2.2.2
Outcome definitions used

Measurement	Criteria	Cut offs for Deficiency in women	References
Anaemia	Haemoglobin	< 12 g/dL	WHO
Iron deficiency	Serum Ferritin	<15mg/L	WHO
Zinc deficiency	Serum Zinc	<10.1mmol/L	IZiNCG
Folate deficiency	Serum Folate	<10 nmol/L	WHO

Table 2.2.3
WHO BMI Cut-off points

Age group	Anthropomotery	Criteria	Classification
Under 19 yrs (Children)	BMI for Age	%<-3SD	Severe wasted
		%<-2SD	Wasted
		%<+1SD	Healthy/Risk of overweight
		%<+2SD	Overweight
		%<+3SD	Obese
19yrs and above	BMI	<18.5	Underweight
		<18.5	Underweight (Adult)
		18.5-24.9	Healthy
		25.0-29.9	Overweight
		>30	Obese

Sources: WHO, 2008

The next chapter presents the 2010 study results.

3.0 RESULTS OF THE 2010 IMPACT STUDY OF IRON FORTIFIED FLOUR

This study was conducted to determine the effect if any, of iron fortified flour on the rates of iron deficiency and anaemia among women of child bearing age in Fiji, after it was implemented nationally.

The section will present the results of the 2010 Impact Survey under the following subheadings:

- Demographics
- Knowledge of flour and flour fortification
- Health Information
- Nutritional status by BMI
- Micronutrient status

Note:

1. The results presented below have been calculated using un-weighted data.
2. Because of the insignificant number of 'Others' in this study, this group will be excluded from the discussion although the result tables may still contain the information for the group.
3. For more detailed analysis of data, please refer to Appendix 6 – 11.

3.1 Demographics

With a response rate of 99.9%, a total of 869 non pregnant women of child bearing age (15-45yrs) participated in the study (Table 3.1.1). Of these 61.4% (n=534) were iTaukeis, 37.4% (n=325) were IndoFijians and 1.2 % (n=10) 'Others'. By age group, 13.2% (n= 115) were 15-<19 yrs and 86.8% (n=754) 19-45yrs. By division, 42.8% (n=372) were from the Central; 40.5% (n=352) from the Western; 13.2% (n=115) from the Northern; and 3.5% (n=30) from the Eastern division.

Interviews at a temple in Rakiraki

Table 3.1.1
Study sample characteristics by ethnicity, age group and division

Characteristics	Number	%
All women	869	100
Ethnicity		
iTaukei	534	61.4
IndoFijian	325	37.4
Other	10	1.2
Age group		
15-< 19yrs	115	13.2
19-45 yrs	754	86.8
Division		
Central	372	42.8
Western	352	40.5
Northern	115	13.2
Eastern	30	3.5

The education levels reported by the survey participants are presented in Table 3.1.2. The majority of the respondents (61.8%) reported having completed secondary education; 18.9% had completed tertiary education and 14.7% had gone as far as primary education. Of those currently studying, 3.2% were still at secondary school and 1.3% was studying at tertiary level.

Table 3.1.2
Education level

Level		n	%
Completed	Primary	128	14.7
	Secondary	537	61.8
	Tertiary	164	18.9
Currently Studying	Secondary	28	3.2
	Tertiary	11	1.3

Most (65.6%) of the participants reported they were married while 31.3% were single (Table 3.1.3).

Table 3.1.3
Marital status

Status	n	%
Married	570	65.6
Single	272	31.3
Others (divorced, widow, defacto)	27	3.1

Approximately a third (36%) of the women surveyed reported having 1-2 children, 23.9% had 3-4 children, 6.8% had 5-6 and 1.4% had more than 7 children and 31.9% reported they had none (Table 3.1.4).

Table 3.1.4
Participants with children

Number of children	n	%
None	277	31.9
1-2	313	36.0
3-4	208	23.9
5-6	59	6.8
>7	12	1.4

Only 16.1% (n=139) reported they were earning an income at the time of the interview. The majority, 83.9% (n=725) reported not earning. The majority of those who were 'earning' (Table 3.1.5), were employed under three main job categories: elementary (included house helpers/cleaners and food vendors), 31.7%; and service workers, 21.6%; and professionals, 17.3%. The rest were distributed across six other categories.

Table 3.1.5
CBA women with occupation

Occupation	n	%
Legislator	2	1.4
Professional	24	17.3
Technician	5	3.6
Clerk	16	11.5
Service worker	30	21.6
Skilled Agriculture & Fish worker	5	3.6
Craft & related	12	8.6
Plant & machinery	1	0.7
Elementary	44	31.7

3. 2 Knowledge of flour and fortification

The participants' knowledge of flour and flour fortification were also investigated. Table 3.2.1 showed the types of flour reportedly consumed by the survey participants.

Overall, most (90.4%) consumed normal flour. Only 4.7% used both normal and whole meal and a similar percentage (4.9%) did not know the type of flour they used. By ethnicity, relatively more iTaukeis consumed normal flour (62.5%) compared to IndoFijians (36.4%).

Table 3.2.1
Types of flour consumed by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
Type of flour	n	%	n	%	n	%	n	%
Normal (white)	786	90.4	491	62.5	286	36.4	9	1.1
Normal & Whole meal	41	4.7	17	41.5	23	56.1	1	2.4
Other/don't know	42	4.9	26	63.9	16	36.1	0	0

FMF brand was purchased by the majority (71.6%) of those surveyed, while only 18.2% purchased Punjas brand (Table 3.2.2). Only 8.4% reported the use of both brands. Relatively more iTaukei (63.8%) compared with IndoFijian (35%) purchased FMF brand.

Overall, the majority (38.1%) identified 'price' (more so for iTaukeis, 63.8% than IndoFijians, 35%) as the main reason for the choice of brand. 'Taste' was identified by 31% while 'availability' was reported by 15%. Relatively more iTaukei (66.2%) identified 'availability' as a choice determinant compared with 33.1% IndoFijian.

Mixing of Flour Samples for Analysis

Table 3.2.2

Brand and choice determination by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
Brand	n	%	n	%	n	%	n	%
FMF	622	71.6	397	63.8	218	35.0	7	1.1
Punjas	158	18.2	90	57.0	67	42.4	1	0.6
Both	73	8.4	40	54.8	31	42.5	2	2.7
Don't know	16	1.8	7	43.8	9	56.3	0	0.0
Choice determination								
Price	331	38.1	250	75.5	78	23.6	3	0.9
Taste	269	31.0	133	49.4	135	50.2	1	0.4
Availability	130	15.0	86	66.2	43	33.1	1	0.8
Brand	64	7.4	28	43.8	34	53.1	2	3.1
Nutrition	19	2.2	3	15.8	16	84.2	0	0.0
Other	56	6.4	34	60.7	19	33.9	3	5.4

Table 3.2.3

Participants who read nutrition labels and had heard of fortified flour by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
Read Nutrition label	n	%	n	%	n	%	n	%
Yes	214	24.9	100	46.7	114	53.3	0	0.0
No	613	71.2	413	67.4	192	31.3	8	1.3
Don't know	34	3.9	16	47.1	16	47.1	2	5.9
Heard of fortified flour								
Yes	78	9.0	44	56.4	33	42.3	1	1.3
No	785	91	485	61.8	291	37.1	9	1.1

A relatively large proportion of those who responded to the question did not read nutrition labels on food packages (71.2%) compared to 24.9% who did (Table 3.2.3). Ethnically, more iTaukeis (67.4%) did not read nutrition labels compared to IndoFijians (31.3%). Only 9% of all participants that answered this particular question reported they had heard about fortified flour while 91% had not. More iTaukeis (61.8%) had not heard about fortified flour compared with 37.1% IndoFijians.

Of those who had heard about fortified flour (Table 3.2.4), only 53.8% knew what it meant and 46.2% were unsure or did not know. By ethnicity, more iTaukeis (80.6%) were unsure compared to 19.4% IndoFijians.

Overall, only 56.2% knew the health benefit of fortified flour.

Table 3.2.4

Participants who had heard of fortified flour and knew the benefits by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
What fortified flour means	n	%	n	%	n	%	n	%
Added iron/nutrients	42	53.8	15	35.7	26	61.9	1	2.4
Others/not sure	36	46.2	29	80.6	7	19.4	0	0.0
Health benefits								
Healthy/prevent anaemia	41	56.2	19	46.3	21	51.2	1	2.4
Other	32	43.8	21	65.6	11	34.4	0	0.0

3.3 Health Information

Participants were also asked about specific health information regarding nutrient supplements (Table 3.3.1 and Table 3.3.2).

Overall, only 16.1% of those surveyed had taken a nutrient supplement in the six months prior to the survey (Table 3.3.1). Of these, slightly more IndoFijians than iTaukeis had taken supplements (56.4% and 42.1% respectively).

Iron and folic acid tablets were reportedly taken by the majority, 57.1%, (n=80). By ethnicity, relatively more IndoFijians (51.3%) than iTaukeis (46.3%) took iron and folic acid supplement.

Taking blood at Lomawai Health Centre

Table 3.3.1

Participants who had taken nutrient supplement in last 6 months by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
Nutrient supplement	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Yes	140	16.1	59	42.1	79	56.4	2	1.4
No	729	83.9	475	65.2	246	33.7	8	1.1
Nutrient Supplement taken								
Iron & folic tablets	80	57.1	37	46.3	41	51.3	2	2.5
Multi-vitamin	25	17.9	7	28.0	18	72.0	0	0.0
Folic, iron & multi-vitamin	20	14.3	8	40.0	12	60.0	0	0.0
Other	15	10.7	7	46.7	8	53.3	0	0.0
Frequency of intake								
Daily	96	69.6	42	43.8	52	54.2	2	2.1
Weekly	21	15.2	9	42.9	12	57.1	0	0.0
Other	21	15.2	6	28.6	25	71.4	0	0.0
For how long								
< 1 month	45	32.6	25	55.6	19	42.2	1	2.2
1-< 12 months	80	58.0	28	35.0	51	63.8	1	1.3
12+ months	13	9.4	4	30.8	9	69.2	0	0
Whose initiative								
Doctor	105	76.1	47	44.8	56	53.3	2	1.9
Own	33	23.9	10	30.3	23	69.7	0	0.0

Daily intake of supplement was reported by 69.6% of the participants with more IndoFijians (54.2%) compared to 43.8% iTaukeis. Most (58%) reported to have been taking supplement for < 12 months with more IndoFijians (63.8%) compared to iTaukeis (35%) who did so. Only 32.6% reported taking supplements for < 1 month prior to the survey with more iTaukeis (55.6%) compared to IndoFijians (42.2%). The majority (76.1%) of participants reported that they took supplement on the doctor's advice. More IndoFijians (69.7%) took supplements on their own initiative compared to 30% of iTaukeis (refer Table 3.3.1).

Table 3.3.2 showed that overall, 31.6% reported taking de-worming tablets at the time of the survey in 2010 while 49.1% took it in 2009. By ethnicity, relatively more iTaukeis than IndoFijians reported taking de-worming tablets during the two year period 2010 and 2009

Table 3.3.2

Participants who took de-worming tablets in last 3 years by ethnicity

Variables	Overall		Ethnicity					
			iTaukei		IndoFijian		Others	
Year	n	%	n	%	n	%	n	%
2010	275	31.6	202	73.5	70	25.5	3	1.1
2009	427	49.1	235	55.0	187	43.8	5	1.2
2008	110	12.7	65	59.1	43	39.1	0	0

3.4 Nutritional status by BMI

The nutritional status of the participants was assessed using BMI. The results are shown in Table 3.4.1

Table 3.4.1

Nutrition status using BMI by age group and ethnicity

Age group	Anthropometry	Criteria	All (% of N)	Population (%)			Comments
				iTaukei	IndoFijian	Others	
Under 19yrs n=77	BMI for age (WHO)	%<-3SD	5.2	0.0	15.4	0.0	Severe wasted
		%<-2SD	9.1	0.0	26.9	0.0	Wasted
		%<+1SD	45.5	62.0	11.5	100.0	Normal/risk of overweight
		%<+2SD	3.9	4.0	3.8	0.0	Overweight
		%<+3SD	0.0	0.0	0.0	0.0	Obese
Adult (19yrs & above) n=792	BMI (WHO)	<18.5.0	5.2 (n=41)	12.2	87.8	0.0	Under weight
		18.5-24.9	31.3 (n=248)	51.2	48.0	0.8	Healthy
		25.0-29.9	32.8 (n=260)	66.5	31.9	1.5	Overweight
		>30.0	30.7 (n=243)	73.7	25.1	1.2	Obese

A participant being interviewed by Ms Norishma Prakash, Nadroga

The new WHO BMI for age standard was used to assess the health of the participants who were 15-18 years (Table 3.4.1). The results showed that majority (45.5%) in this age category were normal or at risk of overweight (% <+1SD), 9.1% were wasted and 5.2% were severely wasted.

Slightly less than a third (31.3%) of the adult (19+ yrs) was in the healthy category. The proportion of those in the healthy category were similar ethnically (iTaukeis 51.2% and IndoFijians 48% respectively). About 32.8% overall were overweight and 30.7% were obese while only 5.2% were underweight. Proportionally more iTaukeis (70.1%) were overweight and obese compared to the IndoFijians (28.5%). However, more IndoFijians than iTaukeis were underweight (87.8% and 12.2% respectively).

3.5 Micronutrient status

Blood samples drawn from women who participated in the survey were analyzed in the laboratory to determine the level of ferritin, haemoglobin, folate and zinc. These micronutrients are present in the flour fortificant.

Table 3.5.1 showed that the mean serum ferritin overall was 76.70ug/L with 41.63 standard devia-

tion (SD). iTaukei women had higher mean (89.30ug/L with 38.69 SD) compared with IndoFijian (55.46ug/L and 38.03ug/L SD). Those under 19yrs had higher mean (82.59ug/L and 44.04 SD) than those 19yrs and over (75.80ug/L and 41.21 SD). Division-wise, the West had the lowest average (67.08ug/L) and 39.84 SD; Northern had a mean of 76.43ug/L and 31.73 SD, while Eastern division had similar a mean of 77.77ug/L and 42.97 SD. The Central division had the highest average (85.84ug/L) and 43.92 SD.

Table 3.5.1

Mean iron (serum ferritin) concentration and prevalence iron deficiency by ethnicity, age group and division

Group Category	N	Serum ferritin levels			Iron deficiency prevalence %	
		Mean µg/L	Range	S.D.	<15µg/L	95% CI
All Women	869	76.70	2 - 215	41.63	7.9	6.3 – 10.0
Ethnicity						
ITaukei	534	89.30	5 - 215	38.69	4.5	3.0 – 6.7
IndoFijian	325	55.46	2 - 177	38.03	13.9	10.4 – 18.2
Other	10	92.60	75 - 135	22.17	0.0	0.0 – 30.8
Age group						
<19yrs	115	82.59	6 - 170	44.04	5.2	1.9 – 11.0
19+yrs	754	75.80	2 - 215	41.21	8.4	6.5 – 10.6
Division						
Central	372	85.84	2 - 180	43.92	5.7	3.6 – 8.7
Western	352	67.08	4 - 143	39.84	12.5	9.3 – 16.5
Northern	115	76.43	10 - 215	31.73	2.6	0.5 – 7.4
Eastern	30	77.77	13 - 206	42.97	3.3	0.1 – 17.2

The prevalence of iron deficiency (<15ug/L) was 7.9% overall. More IndoFijian women (13.9%) had iron deficiency compared to iTaukei women (4.5%).

Table 3.5.2 showed the mean haemoglobin level overall was 12.42g/dL and 1.37 SD. Ethnically, the means were similar (12.64g/dL for iTaukei and 1.17 SD; 12.03g/dL for IndoFijian and 1.57 SD). By age group, the means were also similar (12.53 and 1.30 SD for <19yrs; 12.40g/dL and 1.37 SD for >19+yrs respectively). The mean by the four divisions were also similar although the SD differed slightly as shown in the table.

The prevalence of anaemia (Hb <12.0g/dL) overall was 27.6% with 27.7-30.7 95% CI. IndoFijians had higher rates than iTaukeis (39.7% with 34.4-43.3 95% CI and 20.8% with 17.5-24.5 95% CI respectively)

Table 3.5.2

Mean Hb level and prevalence of anaemia by ethnicity, age group and division

Group Category	N	Haemoglobin level			Anaemia prevalence (%)	
		Mean g/dL	Range	S.D.	Hb<12.0g/dL	95% CI
All Women	869	12.42	5.90-15.50	1.37	27.6	24.7 – 30.7
Ethnicity						
iTaukei	534	12.64	6.20-15.20	1.17	20.8	17.5 – 24.5
IndoFijian	325	12.03	5.90-15.50	1.57	39.7	34.4 – 45.3
Other	10	13.46	12.80-14.30	0.63	0.0	0.0 – 30.8
Age group						
<19yrs	115	12.53	6.20-14.70	1.30	23.5	16.1 – 32.3
19+yrs	754	12.40	5.90-15.50	1.37	28.2	25.1 – 31.6
Division						
Central	372	12.45	5.90-15.50	1.34	26.1	21.7 – 30.9
Western	352	12.35	7.20-15.40	1.49	30.1	25.4 - 35.2
Northern	115	12.47	8.10-15.50	1.16	27.0	19.1 – 36.0
Eastern	30	12.62	10.50-14.30	0.85	20.0	7.7 – 38.6

By age group, more of the older age group, 19+ yrs, were anaemic (28.2%) compared to the younger group, <19yrs (23.5%).

Division-wise, the Western division had the highest rates (30.1%), Northern was next highest with 27%, Central recorded 26.1% and Eastern had 20%.

Table 3.5.3 showed the mean overall serum folate was 26.60nmol/L and 6.45 SD. By ethnicity, the mean for the iTaukei was 27.86nmol/L and 6.39 SD while IndoFijian had a mean of 24.45nmol/L and 5.95 SD. By age categories, the <19yrs recorded a mean of 27.59nmol/L and 6.86 SD while the ≥19yrs showed a mean of 26.45nmol/L and 6.37 SD.

Division wise, the Central division showed the highest mean (28.19nmol/L and 6.88 SD). Eastern division recorded the lowest mean (23.24nmol/L and 6.12 SD). The Northern division had a mean of 26.82nmol/L and 4.34SD; while the Western division recorded a mean of 25.13nmol/L and 6.14 SD.

Table 3.5.3
Mean serum folate and prevalence folate deficiency by ethnicity, age group and division

Group Category	N	Serum folate levels			Folate deficiency prevalence (%)	
		Mean nmol/L	Range	S.D.	<10.0nmol/L	95% CI
All Women	869	26.60	5.1 – 46.2	6.45	1.0	0.5 – 2.0
Ethnicity						
iTaukei	534	27.86	7.0 – 46.2	6.39	1.1	0.5 – 2.6
IndoFijian	325	24.45	5.1 – 40.9	5.95	0.9	0.2 – 2.9
Other	10	29.16	15.1 – 40.2	6.72	0.0	0.0 – 30.8
Age group						
<19yrs	115	27.59	10.7 – 46.2	6.86	0.0	0.0 – 3.2
19+yrs	754	26.45	5.1 – 45.2	6.37	1.2	0.6 – 2.3
Division						
Central	372	28.19	5.1 – 45.2	6.88	1.6	0.7 – 3.7
Western	352	25.13	9.0 – 46.2	6.14	0.3	0.0 – 1.8
Northern	115	26.82	17.9 – 40.2	4.34	0.0	0.0 – 3.2
Eastern	30	23.24	8.7 – 35.7	6.12	6.7	0.8 – 22.1

The results of this study showed that folate deficiency (<10.0nmol/L) appears not to be a problem with overall rate of 1.0% with 0.5-2.0 95% CI. iTaukei recorded 1.1% (0.5-2.6 95% CI) and IndoFijian showed a rate of 0.9% with CI of 0.2-2.9. The ≥19yrs showed a deficiency rate of 1.2% with a 0.6-2.3 95% CI. By division, Eastern division recorded the highest rate (6.7% with a 0.8-22.1 95% CI) while the Central division recorded a 1.6% deficiency rate with 0.7-3.7 95% CI.

Table 3.5.4 showed the results of blood serum zinc. Zinc deficiency (<10.1 µmol/L) does not appear to be a problem among the study population.

Table 3.5.4
Mean serum zinc levels and prevalence zinc deficiency by ethnicity, age group and division

Group Category	N	Serum zinc level			Zinc deficiency prevalence (%)	
		Mean µmol/L	Range	S.D.	<10.0µmol/L	95% CI
All Women	869	13.45	10.1 – 19.2	1.64	0.0	0.0
Ethnicity						
iTaukei	534	13.38	10.1 – 18.2	1.50	0.0	0.0
IndoFijian	325	13.52	10.1 – 19.2	1.82	0.0	0.0
Other	10	14.89	13.2 – 19.2	1.75	0.0	0.0
Age group						
<19yrs	115	13.38	10.5 – 19.2	1.55	0.0	0.0
19+yrs	754	13.46	10.1 – 19.2	1.65	0.0	0.0
Division						
Central	372	13.37	10.1 – 17.2	1.39	0.0	0.0
Western	352	13.34	10.1 – 19.2	1.84	0.0	0.0
Northern	115	13.98	10.9 – 19.2	1.73	0.0	0.0
Eastern	30	13.65	11.9 – 16.8	1.26	0.0	0.0

4.0 IMPACT OF THE NATIONAL FLOUR FORTIFICATION

This section presents the results or impact of the iron fortified flour as an anaemia intervention strategy among women of child bearing age. It will focus on the comparison of the results of the 2004 Micronutrient Survey of Women of Child Bearing Age conducted before the flour fortification legislation was implemented nationally and the results of the 2010 Micronutrient Study of Women of Child Bearing Age, conducted 5 years after flour fortification was implemented.

For comparative purposes, the terms 'before' and 'baseline' will be used interchangeably to refer to the 2004 NNS Micronutrient Survey results while the term 'after' will refer to the 2010 Micronutrient Study results.

4.1 Mean serum level of micronutrients in CBA women before (2004) and after (2010)

Table 4.1.1 compares the blood serum level of the micronutrients iron (ferritin), haemoglobin, folate and zinc), in women of child bearing age. Three (iron, folate and zinc) out of four micronutrients examined are constituents of flour fortificant.

The results showed highly significant differences in the mean serum levels of iron (ferritin), haemoglobin, folate, and zinc between the two years.

Table 4.1.1

Mean blood level of micronutrient before and after implementation of flour fortification

Group Category	Ferritin (µg/L)			Hb (g/dL)			Folate (nmol/L)			Zinc (µmol/L)		
	2004	2010	t-test*	2004	2010	t-test*	2004	2010	t-test*	2004	2010	t-test*
All Women	51.7	76.70	0.000	12.2	12.42	0.001	18.0	26.6	0.000	11.8	13.45	0.000
Ethnicity												
iTaukei	63.6	89.30	0.000	12.5	12.6	0.120	19.3	27.8	0.000	11.7	13.38	0.000
IndoFijian	31.1	55.46	0.000	11.6	12.03	0.003	15.7	24.45	0.000	12.0	13.52	0.000
Age group												
<19yrs	35.5	82.59	0.000	12.52	12.53	0.828	20.4	27.59	0.000	12.4	13.38	0.367
19+yrs	53.0	75.80	0.000	12.12	12.4	0.001	17.9	26.45	0.000	11.7	13.46	0.000
Division												
Central	58.7	85.84	0.000	12.31	12.45	0.302	18.1	28.19	0.000	11.2	13.37	0.000
Western	40.8	67.08	0.000	11.92	12.35	0.001	16.0	25.13	0.000	12.6	13.34	0.004
Northern	57.1	76.43	0.002	12.08	12.47	0.034	20.5	26.82	0.000	11.4	13.98	0.000
Eastern	70.0	77.77	0.541	13.22	12.62	0.026	23.2	23.24	0.959	11.1	13.65	0.000

** T-test significant (p= <0.05)*

Overall, there was significant differences (p=0.000) in mean levels of ferritin after the implementation of flour fortification (51.70µg/L in 2004 and 76.70µg/L in 2010 respectively), an improvement of 25 µg/L.

Although mean serum haemoglobin levels before and after were similar, 12.2 g/dL in 2004 and 12.42 g/dL in 2010, a relatively small improvement of 0.22 g/dL, the differences were significant at p=0.001.

Significant differences were also found in mean serum folate levels (p=0.000): 18.0nmol/L in 2004 and

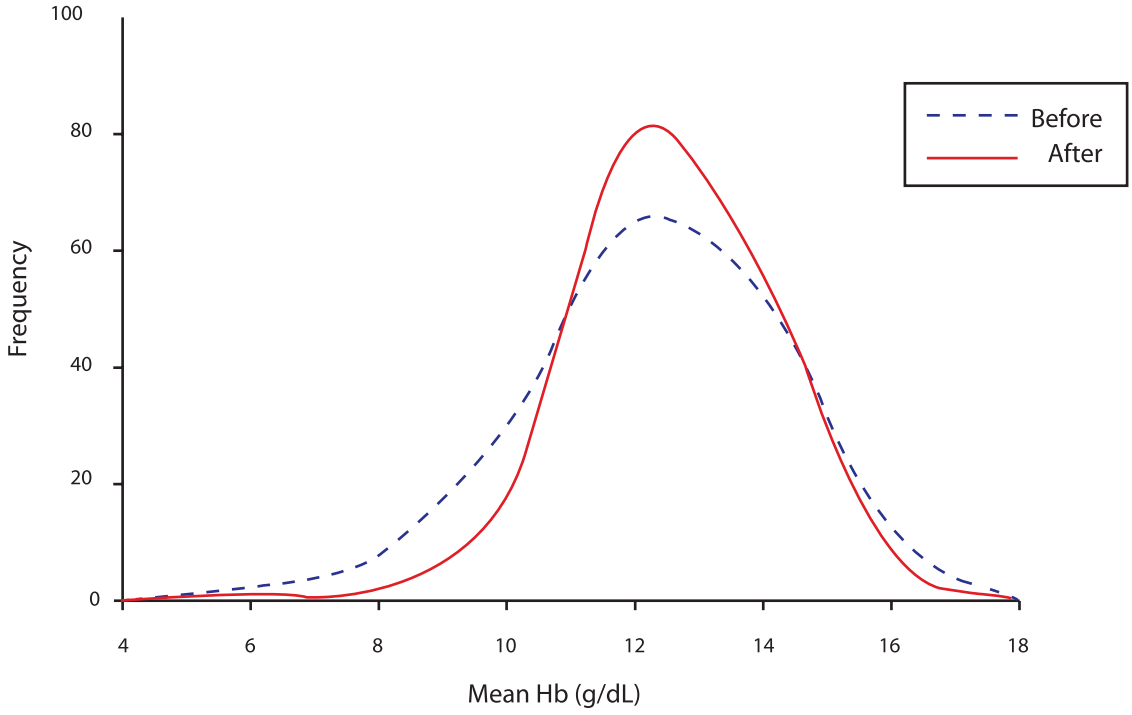
26.60nmol/L in 2010 with an improvement of 8.60nmol/L. Mean serum zinc level showed a 1.65nmol/L improvement after (11.8µmol/L in 2004 and 13.45µmol/Lin 2010), a significant difference at p=0.000 between the two years.

By ethnicity, significant differences (p=0.000) in levels of ferritin, folate and zinc between the two years were found among iTaukeis but Hb levels were not significant (p=0.120). Significant differences were found among IndoFijians in levels of all four micronutrients at p=0.000 for ferritin, folate and zinc and p=0.003 for Hb between the two years.
By age group, no differences in levels of Hb and zinc between the two years were found among the younger group <19yrs while significant differences were found in levels of ferritin and folate (p=0.000).

Division-wise, significant differences were found in levels of ferritin and folate in three except the Eastern division between the two years. With the exception of the Central division, significant differences between were also found in mean Hb although the levels of significance varied.

Figure 3 showed the mean Hb distribution curve before and after the implementation of the fortified flour legislation. Although the mean Hb level before and after were similar (12.20 g/dL and 12.42 g/dL respectively), the curve of the graph indicated a number of small but important changes. A significant number of women had a mean Hb of 12.42 g/dL in 2010 (after) compared with 2004 (before). This was an improvement in mean haemoglobin (0.22 g/dL) compared with baseline. It appears that proportionally fewer women had levels of <10g/dL Hb.

Figure 3
Mean Hb frequency before (2004) and after (2010) flour fortification



4.2 Comparison of micronutrient deficiency between 2004 (baseline) and 2010 (after)

The results of the biochemical analysis of blood samples (Table 4.2.1) showed that overall, deficiency rates of iron, haemoglobin, folate and zinc had improved significantly in 2010. In other words, deficiency rates in all four micronutrients among CBA women had decreased significantly (p=0.000) after flour fortification was implemented.

Overall, the baseline data (2004) showed a 22.9% iron deficiency rate compared to only 7.9% in 2010; iron deficiency anaemia (haemoglobin deficiency) was 40.30% at baseline (2004) whereas it had dropped to 27.6% in 2010; folate deficiency was 8.1% at baseline whereas it had dropped to 1.0% in 2010; zinc deficiency was 39.3% at baseline while the 2010 study found no zinc deficiency in the study population.

[Note: Although the differences in zinc deficiency were highly significant at p=0.000 level between the two years, it needs to be mentioned that there were some questions regarding zinc data for 2004 due to some unusual inconsistently high results.]

Table 4.2.1

Percent micronutrient deficiency before and after implementation of flour fortification

Group Category	% Ferritin <15µg/L			% Hb <12.0g/dL			% Folate <10.0nmol/L			% Zinc <10.1 µmol/L		
	2004	2010	χ^2	2004	2010	χ^2	2004	2010	χ^2	2004	2010	χ^2
All Women	22.9	7.9	0.000	40.3	27.6	0.000	8.1	1.0	0.000	39.3	0.0	0.000
Ethnicity												
iTaukei	11.5	4.5	0.000	33.0	20.8	0.000	6.4	1.1	0.000	39.0	0.0	0.000
IndoFijian	42.8	13.9	0.000	51.2	39.7	0.004	11.0	0.9	0.000	38.0	0.0	0.000
Age group												
<19yrs	30.9	5.2	0.000	34.5	23.5	0.069	7.1	0.0	0.004	37.0	0.0	0.000
19+yrs	22.3	8.4	0.000	40.8	28.2	0.000	8.2	1.2	0.000	39.5	0.0	0.000
Division												
Central	16.5	5.7	0.000	37.8	26.1	0.003	3.9	1.6	0.080	43.2	0.0	0.000
Western	35.1	12.5	0.000	45.1	30.1	0.000	15.3	0.3	0.000	34.1	0.0	0.000
Northern	14.3	2.6	0.000	40.7	37.0	0.017	3.0	0.0	0.062	42.8	0.0	0.000
Eastern	4.9	3.3	0.430	17.5	20.0	0.790	0.0	6.7	0.094	41.0	0.0	0.000

Significant differences (p=0.000) were also found among ethnic groups in all four micronutrients. Significant differences were also found for age groups in most except the <19yrs with haemoglobin at p=0.069.

By division, significant differences (p=0.000) in iron, haemoglobin (except for Eastern) and zinc were found between baseline and 2010. For folate deficiency, differences between the two years were significant only for the Western division.

There was also a significant improvement in the proportion of CBA women suffering from both iron deficiency and anaemia between the two years (Table 4.2.2). A reduction by 50% was established by our study (14.9% in 2004 to 7.5% in 2010) in those who suffered from both iron deficiency and anaemia. Similar pattern was also found in the proportion of CBA women who suffered from deficiencies in all four micronutrients (iron, Hb, folate & zinc) - a reduction of 42% from 68.4% in 2004 to 28.1% in 2010. Fortified flour consumption probably contributed to the reduction in those who were deficient in all four micronutrients.

Table 4.2.2

Prevalence of women with multiple micronutrient deficiencies

Micronutrients	Year				X^2 test
	2004		2010		
	n	%	n	%	
Both iron and anaemia	113	14.9	65	7.5	0.000
All (iron, Hb, folate & zinc)	521	68.4	244	28.1	0.000

4.3 Flour consumption among CBA women between baseline (2004) and after (2010)

Two further tasks were undertaken to help establish whether fortified flour contributed to the improvement in iron content of the diet and therefore reduction in iron deficiency and anaemia among CBA women in our study: i) the total amount of flour and flour consumed by CBA women and; ii) nutrient content of the flour consumed. Data from a 24hr dietary recall collected in 2004 (before fortification) and 2010 (after flour was fortified), were used for the analysis (Iron content was identified as the marker or indicator of proper fortification by the fortification legislation).

Table 4.3.1 showed that overall, significantly more flour and flour products were consumed in 2010 (246.01 g/p/day) compared to baseline (195.14 g/p/day). Significant differences were found in the amount of flour consumed by ethnicity, age group and by two divisions except the northern (p=0.158) and eastern (p=0.897).

Table 4.3.1

Amount of flour and flour product consumed by CBA women

Group Category	Sub-group	Amount of Flour Consumed (mean grams/person/day)		Significance test
		2004 (baseline)	2010	
All	All women	195.14	246.01	0.000
Ethnicity	iTaukei	216.70	280.18	0.000
	IndoFijians	170.17	198.64	0.007
Age group	<19yrs	189.10	253.89	0.037
	19+ years	195.73	244.82	0.000
Division	Central	207.08	259.12	0.000
	Western	183.13	236.69	0.000
	Northern	189.22	230.90	0.158
	Eastern	216.38	252.62	0.897

4.4 Contribution of fortified flour to total micronutrients in the diet

Table 4.4.1 showed the nutrient contribution of flour and flour products to the six micronutrients specified as components of the flour fortificants in Fiji. The results showed highly significant differences (p=0.000) in the contribution of flour to total micronutrients in the diet between the two years (2004 and 2010). Significant increases in levels of all six micronutrients were found after flour fortification was implemented.

In other words, our 2010 study found that the diet of CBA women showed increases in iron content by 2.9 times; 2.5 times for zinc content; 3.7 times for niacin; 2.6 times for riboflavin; thiamin increased by 1.8 times and an increase of 11.3 times in folate, compared to baseline (2004).

Table 4.4.1
Micronutrient contribution of flour and flour products to diet of CBA women before and after flour fortification

Group Category	2004 baseline (n=961)		2010 impact (n=759)		Significance - test
	Mean	% contribution of flour/products	Mean	% contribution of flour/products	
Iron	2.56	13.14	15.3	38.85	0.000
Zinc	1.52	13.47	7.97	34.32	0.000
Thiamin	0.45	21.64	1.55	39.21	0.000
Riboflavin	0.11	8.43	0.51	22.14	0.001
Niacin	2.53	8.35	14.01	31.42	0.000
Folate	38.04	4.37	335.42	49.29	0.000

Two other main food commodity groups known to be good sources of iron (green leafy vegetables and animal protein food), were examined using the same data sources as above, to lend further support (or not) to our findings. The micronutrient contributions to the diet of CBA women were then compared to the relative contribution of flour and flour products (Table 4.4.2). The results showed a significant difference in the contribution of green leafy vegetables to total dietary iron between the two years with an increase of 1.06% from 5.05% in 2004 to 6.11% in 2010. Although the difference in percent contribution of animal protein food to iron in the diet between 2004 and 2010 diet was significant, the change decreased by 7.25% in 2010 (from 22.37% in 2004 to 15.12% in 2010). This could be interpreted as less animal protein food being consumed by the study population.

The percent contribution of flour and flour products to total dietary iron showed the highest increase, 38.85% iron to total iron in 2010 compared to 13.14% in 2004. This could be attributed to the increase in the amount of flour consumed (refer to Table 4.3.1) as well as fortification.

Table 4.4.2
Comparison of three food commodity groups to total iron in the diet of CBA women

Food Group	2004 %	2010 %	Significance - test
Flour & flour products	13.14	38.85	0.000
Green leafy vegetables	5.05	6.11	0.013
Meat/fish/poultry	22.37	15.12	0.052

5.0 FLOUR FORTIFICATION STANDARD COMPLIANCE USING IRON AS INDICATOR

Samples of fortified flour were purchased from local supermarkets, prepared and sent to an independent analytical laboratory specialized in Food and Biological analysis using standard protocols to establish the levels of nutrient fortificants. Using iron content as indicator of proper fortification as stipulated in the legislation ((Fiji Government Gazette, 2003) the results showed compliance by one brand and not quite by the other brand (Table 5.1). The minimum iron standard specified in the Fiji legislation (Gazette, 2003) was 60mg/kg (refer Appendix 2).

Table 5.1
Comparison of iron levels in flour on supermarket shelves

Type of Flour	Iron				Legislated standard
	Brand A		Brand B		
	mg/Kg	% achieved	mg/Kg	% achieved	
Normal	55	91.7	74	123.3	60
Whole meal	51	85	113	188.3	

Flour samples for analysis

Based on the results of the flour analysis, Brand B showed iron levels of 74gm/kg in normal flour and 113gm/kg in whole meal flour. Brand A on the hand was found to contain slightly lower levels of iron (55gm/kg in normal and 51gm/kg in whole meal) representing a 91.7% compliance in normal flour and 85% compliance in whole meal.

6.0 REVIEW OF FLOUR FORTIFICATION POLICY DEVELOPMENT PROCESS

The findings from the review of the flour fortification policy development process by consultant Dr Wendy Snowdon are the subject of a separate report titled, "Legislation to mandate the supply of fortified flour in Fiji: Desktop Review of Policy development process", which was part of Impact Study.

In brief however, flour fortification was placed under the Food Safety Act in 2003. Due to the delay in the promulgation of the Food Safety Act, the Government used the Trade Standards and Control Decree 1992 to legalize the adoption of the flour fortification standard in 2005. However, it was not until 2009 when the Food Safety Act was formally approved that flour fortification standards became mandatory.

An area of weakness highlighted by the review was the lack of a monitoring plan.

The review also drew attention to the importance of partnership between public, private and regional/international sectors, to address nutritional problems of national significance such as anaemia and the need for an adequate monitoring system.

For more details, refer to the report.

7.0 DISCUSSION

The results of this study showed that there have been positive changes (improvements) in iron deficiency and anaemia rates among CBA women in Fiji since fortified flour legislation was enforced. Given the timing and the observed change presented in the previous sections, these might be regarded as 'pretty good' evidence that supports the view that fortified flour might have had some positive effect on the decreased rates of iron deficiency and anaemia.

Positive shifts in the mean blood serum levels of the micronutrients examined were found in 2010. Overall, mean serum ferritin (iron store) had improved by 25µg/L after flour fortification. The differences between the two years (2004 and 2010) were statistically significant at p=0.000. Mean haemoglobin had also improved by 0.22g/dL after flour fortification was legislated with statistically significant (p=0.001) differences between the two years. A comparison of the mean Hb distribution before and after fortified flour (Fig 4.1.1) showed that fewer women were at the lower end of the distribution curve (<10g/dL) while an increased 'bunching' was observed around 12g/dL Hb in 2010. These results suggest that more of the women surveyed in 2010 had obtained the minimum Hb level per day compared to 2004. This could be interpreted as a positive result.

A similar pattern was observed with folate. Differences in mean serum folate level between the two years was statistically significant at p=0.000 - an improvement of 8.6nmol/L in 2010. There was also some improvement in mean zinc serum level of 1.65µmol/L in 2010 (after fortification) and the differences between the two years were statistically significant (p=0.000).

Some positive changes (improvements) in the rate of deficiencies were observed in 2010, 5 years after the fortified flour legislation came into force. In terms of iron (serum ferritin) deficiency (iron store depletion), the differences between 2004 and 2010 were statistically significant (p=0.000) for all categories (overall, ethnicity, age group, and locations) except for the Eastern division (p=0.430). The differences between the two years in the rate of anaemia (Hb deficiency, the end stage of iron depletion in the body), was statistically significantly (p=0.000) for most categories except age group <19yrs (p=0.069) and Eastern division (p=0.790). The change observed was also positive.
Differences in folate deficiency before and after were statistically significant (p=0.000) for most categories except for the Central division (p=0.080), Northern (p=0.062), and Eastern division (p=0.094). Differences in zinc deficiency before and after fortified flour legislation came into force were also statistically significant (p=0.000) for all categories with reduced rates observed in 2010.

CBA women who were found to have suffered from iron deficiency and anaemia had been halved by 2010.

The positive trend shown by the study could be related to the consumption of fortified flour and flour products. The differences in the average amounts of flour and flour products consumed before flour fortification and after ((195.14 g/person/day and 246.01g/person/day respectively) were statistically significant (p=0.000). With the exception of the Northern division (p=0.158) and Eastern (p=0.897), the differences between the two years were also statistically significant for other categories.

The analysis results of the contribution of flour and flour products to total micronutrients in the diet of the study population showed statistically significant differences between the two periods (2004 and 2010). Percent contribution of flour and flour products to specific micronutrients in the diet after flour fortification showed iron increased 2.9 times; zinc increased 2.5 times; thiamin increased 1.8 times; riboflavin increased 2.6 times; niacin increased 3.7 times; folate increased 11.3 times. These results have shown major improvements in dietary intake of micronutrients.

The contribution of two other commodity food groups green leafy vegetables (iron-rich food-source) and meat to total iron in a day's diet was also examined and compared with the flour and flour products. Green leafy vegetables contributed 5.05% in 2004 with only a slight increase (6.11%) in 2010. In 2004, animal protein food (the best source of iron) contributed 22.37% iron to total iron in the day's diet but decreased to 15.12% in 2010. The differences between the two years were significant for green leaves (p=0.013) as well as for meat (p=0.052) although there was a decrease in percent contribution of meat to total iron in the diet of the study population. This reduction could possibly be attributed to the high cost of meat/fish/poultry. Although flour and flour products still contributed the highest proportion of iron to the total iron in the diet, it must be remembered that the total amount of dietary iron that is absorbed depends on a number of factors: the meal or diet composition, the iron status of the individual and the bioavailability of the iron fortificant. The iron

compound used as fortificant in Fiji is less well absorbed (Zimmermann et al, 2005). Biochemical analysis of blood showed significant improvement in levels of iron (and other nutrients) in 2010 compared to 2004. Fortified flour, being more nutritious than non fortified flour, will have contributed significantly to the levels of iron indicated by the laboratory analysis of blood taken from the sample population.

The results of our study appear consistent with similar studies in other developing countries that showed fortified flour have been successful in lowering the rates of iron deficiency and anaemia (Zimmermann and Hurrell, 2007; Allen, 2006; Al-Dallal and Hussain, 200; Hurrell et al, 2002).

The way forward

Literature indicates that the elemental iron powder (in the three forms: electrolytic, carbonyl and reduce) is by far the most widely used fortificant for flour because it is relatively cheaper and flour can be stored for longer periods without developing unacceptable sensory changes (Zimmermann and Hurrell, 2007; Zimmermann et al 2005; Hurrell et al, 2002; Hurrell, 1997). However, elemental iron powders are less well absorbed than other iron compounds such as ferrous sulfate. In general, elemental iron powder are only half as well absorbed as ferrous sulfate although early human studies showed discrepant results ranging from very low to equivalent to ferrous sulfate (Zimmermann, et al, 2005; Hurrell et al 2002). Consequently, experts recommend that the amount of elemental iron powder added to flour should be sufficient to provide double the amount of iron.

Zimmermann and Hurrell (2007) in their review of iron fortification programmes recommended the following fortificants for developing countries (in order of priority) based on efficacy studies:

<u>For most foods (e.g. cereal flours)</u>

- Ferrous sulphate
- Ferrous fumarate
- Encapsulated ferrous sulphate or fumarate
- Electronic iron (at twice the amount vs ferrous sulphate)
- Ferric pyrophosphate (at twice the amount vs ferrous sulphate)
- NaFeEDTA

<u>For high phytate cereal flour</u>

- NaFeEDTA

The above list showed that the iron fortificant used in Fiji (hydrogen reduced electronic iron) falls two thirds of the way down the priority list. Serdula et al (2010) and Hurrel et al (2010) voiced their concern that despite the WHO/FAO guidelines and the experts specific call, many countries still use elemental iron fortificants (i.e. some form of hydrogen-reduced iron and atomized iron) that are poorly absorbed.

A review of levels of iron fortification for wheat flour by Hurrell et al (2010) recommended iron fortification levels according to iron compounds and daily flour consumption based on the calculated minimum iron dose that improves iron status in efficacy studies (Table 7.1).

Our 2010 Impact Study showed the average daily consumption of flour and flour products as 246.01 gram flour/day which falls within 150-300g/day as indicated in Table 7.1. Fiji's current iron compound fortificant,

Table 7.1
Recommended iron fortification levels for wheat flour

Flour Consumption g/day	NaFeEDTA	Ferrous sulfate or ferrous fumarate	Electrolytic iron powder
>300	15	20	40
150-300	20	30	60
75-149	40	60	Not recommended
<75	40	60	Not recommended

Source: Hurrell et al 2010

electronic iron powder, and level, 60mg/kg, are also consistent with the recommendations above.

The new levels of nutrients recommended by WHO (WHO, 2009), for flour fortification based on i) extraction, ii) fortificant compound, and iii) estimated per capita flour availability are set out on Table 7.2 below.

Table 7.2
Recommended average levels of nutrients to consider adding to fortified flour

Nutrient	Flour extraction rate	Compound	Level of nutrient to be added in parts per million (ppm) by estimated average per capita wheat flour availability (g/day)[1]			
			<752 g/day	75-149 g/day	150-300 g/day	>300 g/day
Iron	Low	NaFeEDTA	40	40	20	15
		Ferrous sulfate	60	60	30	20
		Ferrous Fumarate	60	60	30	20
		Electrolytic Iron	NR3	NR3	60	40
	High	NaFeEDTA	40	40	20	15
Folic Acid	Low or high	Folic Acid	5.0	2.6	1.3	1.0
Vit. B_{12}	Low or high	Cyanocobalamin	0.04	0.02	0.01	0.008
Vit.A	Low or high	Vit. A Palmitate	5.9	3	1.5	1
Zinc[4]	Low	Zinc Oxide	95	55	40	30
	High	Zinc Oxide	100	100	80	70

1 These estimated levels consider only wheat flour as main fortification vehicle in a public health program. If other mass-fortification programs with other food vehicles are implemented effectively, these suggested fortification levels may need to be adjusted downwards as needed.

2 Estimated per capita consumption of <75 g/day does not allow for addition of sufficient level of fortificant to cover micronutrients needs for women of child bearing age. Fortification of additional food vehicles and other interventions should be considered.

3 NR= Not Recommended because very high levels of electrolytic iron needed could negatively affect sensory properties of fortified flour.

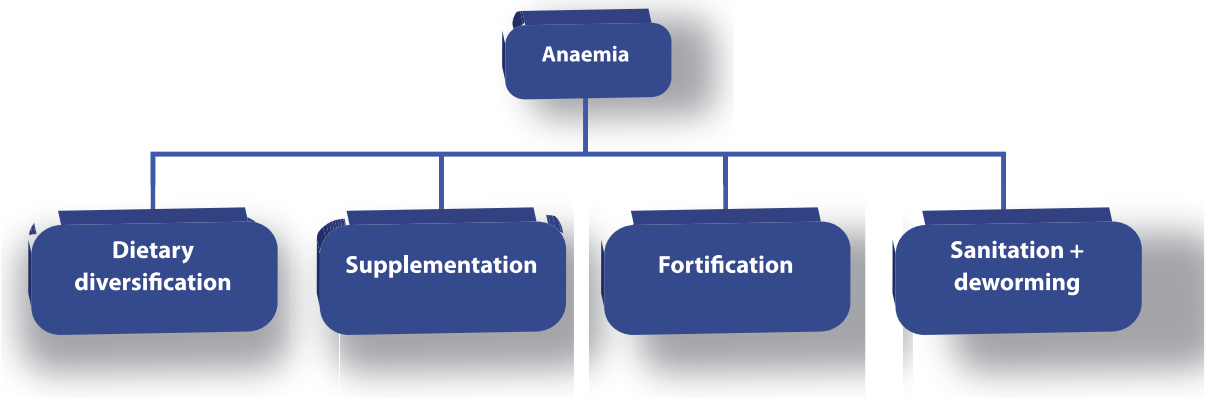
4 These amounts of zinc fortification assume 5 mg zinc intake and no additional phytate intake from other dietary sources.

An examination of Table 7.2 shows on the whole that Fiji's current fortificant compounds and levels appear to conform to the new recommendations, except for zinc (current level of 30 mg/kg) whereas 40 mg/kg is suggested for low flour extraction rate. However, expert group pointed out that the decision to adopt the latest recommended levels and the compounds to be used lies with national decision makers in each country (Serdula et al 2010).

The Ministry of Health therefore may need to discuss and decide whether to adopt relevant parts of the new recommendations and in particular the use of encapsulated or non-encapsulated ferrous sulfate or fumerate as iron fortificant if Fiji. It must be remembered however, that if sensory changes or cost limits the use of these compounds (ferrous sulfate or fumerate), the current compound (electrolytic iron) and level should be considered as the second best choice (Serdula et al 2010).

Food fortification must be considered in its proper context – that it is only one food-based intervention and is not a 'curative' intervention (Serdula et al 2010). Figure 4 illustrates that fortification is only one component in a holistic anaemia control and prevention programme.

Figure 4
Role of food fortification in context



Fortification needs to be complemented with other preventive interventions strategies such as dietary diversification/strategies designed to maximize the bioavailability of both the added and intrinsic food iron, supplementation, and sanitation along with deworming (Hurrell et al 2010; Hurrell et al 2002; Martinez-Navarrete et al, 2000).

8.0 CONCLUSION

The answers to the four questions posed at the beginning would be the best way to conclude this report.

1. The data from the study showed that the prevalence of anaemia, iron, zinc & folate deficiencies were found to be lower after the flour fortification programme was implemented nationally.
    a. The differences observed in the rate of anaemia, iron, zinc and folate deficiencies between baseline and 2010 (after) were highly significant. The changes showed marked improvements with much lower deficiency rates after fortification was nationally implemented.
    b. Based on the results of our study, the national fortification of flour with iron (& other micronutrients) may have contributed to the improvement in the reduction of deficiency rates.
    c. Comparisons of the relative contributions of three food categories (known to be good sources of iron) to micronutrients in the diet of women of Child Bearing Age (green leafy vegetables, meat and fortified flour and flour products) showed that fortified flour and flour products contributed the greatest amount of iron and other micronutrients in 2010 compared to 2004.
    d. Although it is not be possible to say with absolute confidence how much of the change observed can be attributed to fortified flour given other on-going interventions such as iron supplementation, all indications point to the fact that iron fortified flour have contributed positively to the improvements in micronutrient levels in the diet of CBA women in this study especially iron level and a reduced rate of anaemia, as illustrated by the improved micronutrient levels in their blood.

Because of the way flour fortification was implemented nationally five years before this study was conducted, there was no other alternative but to adopt the study design used. It would be fair to say however, that even with this limitation the results strongly suggest that fortified flour has contributed positively to the improvements in iron and other micronutrient in the diet of CBA women in this study.

9.0 RECOMMENDATIONS

It is recommended that:

1. Since flour fortifications is only one approach to address anaemia, a concerted effort should be made to address anaemia in Fiji holistically by complementing flour fortification with other strategies such as practical dietary diversification, continue with iron supplementation program and sanitation;
2. A rigorous effort is made to educate the communities about food choices for nutritious meals that are practical, relevant and culturally appropriate;
3. A practical intensive education programme is developed and implemented to educate the public to read food labels before purchasing;

4. The Ministry of Health with flour millers develop a shared monitoring and evaluation system/ plan to ensure legislation and standards compliance are adhered to by all stakeholders including importers and distributors;
5. That the Ministry of Health in partnership with the local Flour Millers use the results of this study to review the current fortificant standards and consider adopting relevant parts of the new WHO/FAO recommendations and in particular:
    a. Using either ferrous sulfate or fumarate compounds as fortificant if at all possible;
    b. Increasing zinc oxide to 40mg/kg;

10.0 LIMITATIONS

The limitations of the study included:

1. A cluster randomized controlled study would have been technically ideal to properly assess the efficacy of the fortified flour strategy but this was not possible due to the method used to implement legislation as well as the time lapse between implementation and this study.
2. The use of only one biochemical index (serum ferritin) to assess all stages of iron. No single biochemical index can assess all stages but because of funding constraints, it was not possible to use more than one indicator.

Peni interviewing at Lagi Health Centre

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11	Daily Nutrient Intake compared to USDA DRI by Ethnicity

Appendix 1: List of Field Workers

No.	Field worker	Sub-division	Position
Supervisors			
1	Alvina Deo	NFNC	Nutritionist
2	Anshu Deo	NFNC	Project Assistant
3	Penina Vatucawaqa	NFNC	Research Officer
Western Health Services			
1	Norishma Prakash	Sigatoka	Dietitian
2	Bhaoni Nandani	Sigatoka	Staff Nurse
3	Senimelia Macanawai	Sigatoka	Staff Nurse
4	Alitia Navukula	Sigatoka	Staff Nurse
5	Setaita Nasiga	Sigatoka	Staff Nurse
6	Nisha Jaffar	Nadi	Dietitian
7	Nanise Molly	Nadi	CRA
8	Masiwini Waikarawa	Nadi	Peer Educator
9	Adi Ema Sorowale	Nadi	Staff Nurse
10	Maca Rokomalani	Lautoka/Yasawa	Dietitian
11	Nemani Nacei	Lautoka/Yasawa	Staff Nurse
12	Satendra Prasad	Lautoka/Yasawa	CRA
13	Sesenieli Vesikula	Lautoka/Yasawa	Staff Nurse
14	Kesaia Nawaqaliva	Lautoka/Yasawa	Staff Nurse
15	Yogeeta Singh	Ba	Dietitian
16	Merelita Bakaloa	Ba	Staff Nurse
17	Navlita Lal	Ba	Staff Nurse
18	Kelera Drodro	Ba	CRA
19	Shidavani Ram	Tavua	Dietitian
20	Taraivini Nakoli	Tavua	CRA
21	Torika Luqa	Tavua	Staff Nurse
22	Akata Nale	Tavua	Staff Nurse
23	Merewai Bulou	Ra	Dietitian
24	Fulori Lewatoga	Ra	CRA
25	Mereoni Tavo	Ra	Staff Nurse
26	Luisa Vosataki	Ra	Staff Nurse
Northern Health Services			
1	Viniana Sokonawai	Cakaudrove	CRA
2	Siliveni Hazelman	Cakaudrove	SDHS
3	Tomasi Matamusuka	Cakaudrove	PO Rotavirus
4	Ateca Ikanidrodro	Cakaudrove	DN
5	Loreen Kumari	Macuata	Dietitian
6	Susana Rika	Macuata	CRA
7	Mere Matanisiga	Macuata	Zone Nurse
8	Lavenia Lave	Macuata	Nurse
9	Swastika Lal	Macuata	Dietitian
10	Veniana Vakaruru	Macuata	Zone Nurse
11	Losena Yabakidua	Macuata	SDHS
12	Cathy May	Macuata	Zone Nurse
13	Penina Maria	Macuata	Nurse
14	Raijieli Senimaqo	Macuata	Volunteer
15	Unaisi Basacala	Macuata	Nurse
16	Vilisi Tabua	Macuata	Dietitian
17	Yavini Velovelo	Macuata	DN Lagi
18	Peni Tabua	Macuata	Volunteer
CentEast Health Services			
1	Mohini Lata	Suva	Zone Nurse
2	Melita Ritova	Suva	Zone Nurse
3	Jioji Fesaitu	Suva	Dietitian
4	Ilisapeci Vocea	Suva	Zone Nurse
5	Litiana Cakaunitabua	Suva	Zone Nurse
6	Joana	Suva	Zone Nurse
7	Vani Kunabuli	Suva	Dietitian
8	Akisi Rayawa	Suva	Zone Nurse
9	Viniana Vakaloloma	Naitasiri	Dietitian
10	Keleni Domolekula	Naitasiri	DN
11	Ana Kalokalo	Naitasiri	Health Sister
12	Salome Tuivuna	Naitasiri	Zone Nurse
13	Aralai Mocelutu	Tailevu	Dietitian
14	Milikiti Tikoduadua	Tailevu	CRA
15	Mere Buna	Tailevu	DN
16	Shalveena Jeet	Rewa	Dietitian
17	Lusiana Dimuatabu	Rewa	CRA
18	Meredani Ranuku	Rewa	Zone Nurse
19	Mariana Vuinakelo	Rewa	Health Sister
20	Akanisi Wati	Lomaiviti	Zone Nurse
21	Arleen Sukhu	NFNC	Data Entry Officer

Appendix 2: Fiji Gazette for Flour Fortification

FIJI ISLANDS GOVERNMENT GAZETTE SUPPLEMENT

No. 34 FRIDAY, 14th November 2003

[LEGAL NOTICE NO. 65]

TRADE STANDARDS AND QUALITY CONTROL DECREE 1992
(DECREE NO. 24 OF 1992)

FIJI STANDARDS SPECIFICATIONS DECLARATION

PURSUANT to Section 25(2) of the Trade Standards and Quality Control Decree 1992 and after consideration of the recommendation of the Trade Standards Advisory Council, I declare that the specification in the Schedule hereto is to be a Fiji Standards Specification for the purposes of the Decree.

Schedule

Name of Specification	*Fiji Specification Number*
Fortification of Wheat Flour	FS 5 : 2003

Dated this 7th day of November 2003.

T. VUETILOVONI
Minister for Commerce,
Business Development & Investment

V. NAREKI Government Printer, Suva, Fiji—2003
Official Printer Since 1883
Price: 52c
109/FRGS/2003—1,350

Appendix 2: Fiji Gazette for Flour Fortification

CALCULATIONS ON MINIMUM STANDARDS ENRICHED WHEAT FLOUR

	A Level to add (mg/kg)	N Natural Level (mg/kg)	R Processing Retention (%)	S Minimum Standards (mg/kg)
Thiamin	5.2	2.0	90	**6.0**
Riboflavin	2.2	0.2	90	**2.0**
Niacin	50	10	98	**55**
Folic Acid	1.6	0.1	95	**1.5**
Iron	55	10	100	**60**
Zinc	25	7	100	**30**

Level to add calculation: $A = (S/0.93x(R/100))+N$

SUGGESTIONS FOR REGULATIONS GOVERNING THE FORTIFICATION OF WHEAT FLOUR

STANDARDS FOR FORTIFIED WHEAT FLOUR

Fortified wheat flour is the food prepared by grinding and bolting cleaned wheat to which vitamins and minerals have been added so as to provide the following minimum levels of micronutrients in the flour at the point of sale.

Micronutrient	Micronutrient Source	Standard (mg/kg)
Thiamin	Thiamin Mononitrate	**6.0**
Riboflavin	Riboflavin	**2.0**
Niacin	Niacin	**55**
Folic Acid	Folic Acid	**1.5**
Iron	Elemental Iron powder*	**60**
Zinc	Zinc Oxide	**30**

*Iron powder of 325 mesh (45 microns average diameter) or smaller made by an electrolytic reduction process or by a process that gives bioavailability equivalent to that made by an electrolytic process.

The fortification standards shall be the minimum total levels of the nutrient in the dry flour or meal product including all nutrients naturally present.

Iron content will be used as an indicator of proper fortification. The iron content of flour is to be measured by AACC method 40-41A, Iron, Quantitative (colorimetric) or AACC method 40-70 Elements by Atomic Absorption Spectrophotometry (*American Association of Cereal Chemist, 2000, Approved Methods of the AACC, 10th Ed., The Association, St. Paul, MN*).

Appendix 3: 2010 Impact Study Survey Sites

EA No.	Localities	Sub-division	Area description
1	Matailobau Tikina	Naitasiri	Laselevu Vill, Nasalia Vill, Nawaisomo Vill, Wairuarua Vill, Udu Sett, Kadavu Sett, Matasila Sett & Draunidakua Sett
2	Wainimala Tikina	Naitasiri	Nakorovou Vill, Narokorokoyawa Vill, Matawailevu, Nasauvere Vill, Nasava Vill & Tubarua Vill
3	Bau Tikina	Rewa	Vusuya Rd Sett, Raralavu Sett, Maumi Sett.
4	Verata Tikina	Tailevu	Naiyala Sec Sch & Sett, Vatukarasa Vill, Nameka Vill, Natuva, Tonia Vill, Waidradra Sett, Namoto Sett, Coloi Sett.
5	Suva Ward	Suva	Nasova Police Compound
6	Samabula Ward	Suva	HA land in Viria Road, Vusavusa Rd, Sarosaro Pl.
7	Tamavua Ward	Suva	Off Cunnigham Rd-Rokosawa Rd, Valley Dr, Nacagilevu Cres, Racule Dr, Marshall Pl
8	Tamavua Ward	Suva	Tamavua-I-wai Sett, Reservoir Rd, along Tamavua River
9	East of Nasinu River	Suva	Narere Rd, Mana St, Qari Pl
10	East of Nasinu River	Suva	Makoi Rd, Sabera Pl, Matanisiga St, Chandanee Pl, Uca Pl
11	Kings Road North	Suva	Caubati- Cakacaka Rd, Sivi rd, Kuruva Rd
12	Kings Road North	Suva	Daniva Rd, Kanace rd, Ogo Pl, Nuqa Pl
13	Lami - Western Ward	Suva	Marine Drive, Isa Lei Rd, Stirling Place.
14	Gau Tikina	Lomaiviti	Qarani Vill, Vione Vill, Lekanai Vill, Vanuaso Vill, Qarani Govt St., Nacasave Sett, Vunikavika Sett, Akea Sett, Dranu Sett.
15	Nasavusavu Tikina	Cakaudrove	Naweni Sett, Draunimoli, Bakanawa, Duilomaloma, Tacilevu Vill, Drekeniwaicivi, Navilaca Sett
16	Dogotuki Tikina	Macuata	Cawaro Vill, Qaranivai Vill, Lagi Vill, Keda Vill, Sucudua Sett, Koroboriri Sett, Vunimako Sett, Nawatu, Udutu Sett, Nasigasiga Sett.
17	Labasa Tikina	Macuata	Nubu Vill, Navukebuli Vill, Vuisavu, Nabutubutu, Kurukuru Sett.
18	Sasa Tikina	Macuata	Naravuka, Saivou, Vesidrua, Nakavika, Vucetoka, Qeresomi, Nacareyaga
19	Ba Tikina	Ba	Waivuka Sett, Vulavula Sett, Navoli [part] Sett.
20	Ba Peri	Ba	Valele Rd meets Kings Rd, Vadraulailai, Clopcott
21	Nawaka Tikina	Nadi	Nagado Vill and Setts
22	Nadi Peri	Nadi	Vunayasi Vill
23	Tavua Tikina	Tavua	Tovatova Sett [part], Masimasi Sett [part], Davota Sett [part] & Malele Sett [part]
24	Vuda Tikina	Lautoka/Yasawa	Vakabuli Vill & Vakabuli Sett [part]
25	Waiyavi Ward	Lautoka/Yasawa	Namoli Vill, Namoli Av, Korotu Ln
26	Tavakubu Ward	Lautoka/Yasawa	Tavakubu Rd, Ayohdya Prasad, Shiu Raj St
27	Magodro Tikina	Nadroga	Navaga Vill, Nadevo Vill, Nasivikoso Vill, Lamiti, Raralevu, Vunauma, Narota Sett, Nasamolo Sett, Vunamaru Sett, Sovusovu Sett, Vatudaguru Sett, Vatukanatolu Sett, Nakuruleade Sett,
28	Cuvu Tikina	Nadroga	Emuri Vill & Sett, Semo Vill, Nabau Vill, Uluisila [part], Vavinaqiri, Vibua, Cuvu, Tagitagi Sett
29	Malomalo Tikina	Nadroga	Lomaiwai Vill, Kubuna Vill, Lomawai Sett [part] & Koromani/Navutu Sett.
30	Rakiraki Peri	Ra	Waimari Rd, Colasi Sett,

Appendix 4: General Questionnaire

2

NATIONAL FOOD AND NUTRITION CENTRE

Impact Study of Iron Fortified Flour in CBA Women in Fiji

General Questionnaire

ENUMERATION AREA NO: ☐☐

NAME OF RESPONDENT: _____

RESPONDENT ID: ☐☐

NAME OF INTERVIEWER: _____

INTERVIEWER ID: ☐☐

DATE OF INTERVIEW : ☐☐ Day ☐☐ Month ☐☐ Year

FIELD CHECKER: Team Leader

Date Checked:

Checker ID:

OFFICIAL USE ONLY

Date Received:

Checker ID

Supervisors Name: _____

Supervisors Signature: _____

Date: _____

Appendix 4: General Questionnaire

EA#		Respondent ID	

A. Socio-economic and Demographic Information

Office Use Only

			Please tick (√)	
1.	How old are you?	/___/___/ years		IS01
2.	What is your date of birth?	/___/___/___/___/___/___/___/___/ / d / d / m / m / y / y / y / y /		IS02
3.	To which ethnic group do you belong?	1. Fijian		IS03
		2. Indo-Fijian		
		3. Other		
4.	How many children have you had?	Number:		IS04
5.	Marital Status	1. Married		IS05
		2. Single		
		3. Divorce		
		4. Widow		
		5. Other, specify_____		
6.	What was the **highest level** of education you have completed?	1. Never been to school		IS06
		2. Primary School		
		3. Secondary education		
		4. Tertiary education		
		5. Currently attending secondary school		
		6. Currently attending tertiary education		
7.	Are you currently earning some money for a living?	1. Yes		IS07
		2. No **If no, go to Q9**		
8.	What is your present occupation?	_____		IS08

Appendix 4: General Questionnaire

				EA#	Respondent ID

B. Flour Fortification-Awareness/Knowledge/ Practices and Behaviour

Please tick (√) Office Use Only

9.	What type of flour do you **mostly** consume at home?	1. Normal		IS09
		2. Wholemeal		
		3. Normal & Wholemeal		
		4. Roti flour		
		5. Atta		
		6. Sharps		
		7. Other (specify) _____		
		8. Don't know		
10.	What brand of flour do you **normally** buy?	1. FMF		IS10
		2. Punjas		
		3. Both		
		4. Don't know		
11.	What determines your choice of flour?	1. Price		IS11
		2. Taste		
		3. Availability		
		4. Brand		
		5. Nutrition		
		6. Other (specify)_____		
12.	Do you read the nutrition label before buying the flour?	1. Yes		IS12
		2. No		
		3. Don't know		
13.	Have you heard about fortified flour?	1. Yes		IS13
		2. No **If no, go to Q16**		
14.	If yes, what is fortified flour?	_____		IS14
		_____		
15.	Do you know of any health benefits of eating fortified flour?	_____		IS15
		_____		

3

Appendix 4: General Questionnaire

EA#		Respondent ID		

C. Health Information

Please tick (√) Office Use Only

16.	In the past 6 months, have you taken any nutrient supplements such as tablets?	1. Yes		IS16
		2. No **If no, go to Q21**		
17.	Which supplements are you taking? **[show pictures of tablets]**	1. Iron Tablets		IS17
		2. Folic Acid		
		3. Multi-vitamins		
		4. Iron & Folic		
		5. Iron & Multi-vitamins		
		6. Folic & Multi-vitamins		
		7. Other (specify) _____		
18.	Did the doctor prescribed the tablets or was it taken on your own initiative?	1. Doctor		IS18
		2. Own		
19.	How often do you take these tablets?	1. Daily		IS19
		2. Weekly		
		3. Other (specify) _____		
20.	How long have you been taking this tablet?	1. Weeks (1-3 weeks)		IS20
		2. Months (1 -11 months)		
		3. Years (12 months & above)		
21.	When was the most recent deworming tablets (for filariasis and hookworm) taken?	1. 2010		IS21
		2. 2009		
		3. 2008		
		4. Other (specify)_____		

Appendix 4: General Questionnaire

EA#		Respondent ID	

D. Measurements

Scale Code ☐

Stadiometer Code ☐

	First Observation	Second Observation	Third Observation	
Technician Code	☐☐	☐☐	☐☐	
22. Weight	_____ kg	_____ kg	_____ kg	*IS22.*
23. Height	_____ cm	_____ cm	_____ cm	*IS23.*

24. Blood sample taken by Lab Technician? [Please tick (√)] 1. Yes ☐ 2. No ☐ **IS24.** ☐

Thank you for your time and cooperation!

Appendix 5: Food Recall

3

NATIONAL FOOD AND NUTRITION CENTRE

Impact Study of Iron Fortified Flour in CBA Women in Fiji

FOOD RECALL QUESTIONNAIRE

ENUMERATION AREA NO: ☐☐

NAME OF RESPONDENT: _____

RESPONDENT ID: ☐☐

NAME OF INTERVIEWER: _____

INTERVIEWER ID: ☐☐

DATE OF INTERVIEW : ☐☐ ☐☐ ☐☐

Day Month Year

DAY OF INTERVIEW : ☐

FIELD CHECK: Team Leader	OFFICIAL USE ONLY
Date Checked:	Date Received:
Checker ID:	Checker ID:

Supervisors Name: _____

Supervisors Signature: _____

Date: _____

Time Started:	Time Ended:

Appendix 5: Food Recall

EA#		Respondent ID	

Step 2A: Record of All Food Intake

Number	Food/Drinks [Q1]	Meal times [Q2]	Full description of food/drink (name, type, brand, preparation method) [Q3]	How much of this food did you actually eat/drink? [Q4]	
				Amount in h/hld measure, model or weight. [Q4A]	Calculated weight (gms/mls) [Q4B]

EA#		Respondent ID	

Step 2A: Record of All Food Intake

Number	Food/Drinks [Q1]	Meal times [Q2]	Full description of food/drink (name, type, brand, preparation method) [Q3]	How much of this food did you actually eat/drink? [Q4]	
				Amount in h/hld measure, model or weight. [Q4A]	Calculated weight (gms/mls) [Q4B]

Appendix 5: Food Recall

EA#		Respondent ID	

Step 2A: Record of All Food Intake

Number	Food/Drinks [Q1]	Meal times [Q2]	Full description of food/drink (name, type, brand, preparation method) [Q3]	How much of this food did you actually eat/drink? [Q4]	
				Amount in h/hld measure, model or weight. [Q4A]	Calculated weight (gms/mls) [Q4B]

EA#		Respondent ID	

Step 2A: Record of All Food Intake

Number	Food/Drinks [Q1]	Meal times [Q2]	Full description of food/drink (name, type, brand, preparation method) [Q3]	How much of this food did you actually eat/drink? [Q4]	
				Amount in h/hld measure, model or weight. [Q4A]	Calculated weight (gms/mls) [Q4B]

Appendix 5: Food Recall

EA#		Respondent ID	

Step 2B: Recipe Recording Sheet

Note: Recipe information should only be collected if participant knows all ingredients and amounts

Food ref No. [Q5]	Recipe Description [Q6]	No. of people consumed this food [Q7]		Ingredient description [Q8]	Raw or Cooked (R or C) [Q9]	Ingredient Amounts [Q10]		
		Children (<12 years) [Q7A]	Adult (≥12 years) [Q7B]			Amount in h/hld measure, model or weight if known [Q10A]	Calculated weight (gms/mls) [Q10B]	Amount eaten by this person [Q10C]

EA#		Respondent ID	

Step 2B: Recipe Recording Sheet

Note: Recipe information should only be collected if participant knows all ingredients and amounts

Food ref No. [Q5]	Recipe Description [Q6]	No. of people consumed this food [Q7]		Ingredient description [Q8]	Raw or Cooked (R or C) [Q9]	Ingredient Amounts [Q10]		
		Children (<12 years) [Q7A]	Adult (≥12 years) [Q7B]			Amount in h/hld measure, model or weight if known [Q10A]	Calculated weight (gms/mls) [Q10B]	Amount eaten by this person [Q10C]

Appendix 5: Food Recall

EA#		Respondent ID	

Step 2B: Recipe Recording Sheet

Note: Recipe information should only be collected if participant knows all ingredients and amounts

Food ref No. [Q5]	Recipe Description [Q6]	No. of people consumed this food [Q7]		Ingredient description [Q8]	Raw or Cooked (R or C) [Q9]	Ingredient Amounts [Q10]		
		Children (<12 years) [Q7A]	Adult (≥12 years) [Q7B]			Amount in h/hld measure, model or weight if known [Q10A]	Calculated weight (gms/mls) [Q10B]	Amount eaten by this person [Q10C]

EA#		Respondent ID	

Step 2B: Recipe Recording Sheet

Note: Recipe information should only be collected if participant knows all ingredients and amounts

Food ref No. [Q5]	Recipe Description [Q6]	No. of people consumed this food [Q7]		Ingredient description [Q8]	Raw or Cooked (R or C) [Q9]	Ingredient Amounts [Q10]		
		Children (<12 years) [Q7A]	Adult (≥12 years) [Q7B]			Amount in h/hld measure, model or weight if known [Q10A]	Calculated weight (gms/mls) [Q10B]	Amount eaten by this person [Q10C]

Appendix 6: Population Characteristics

Characteristics	Groups	Sample Size	All (% of N=869)	Population %		
				iTaukei	Indo-fijians	Others
All	**All**	869	100	61.4	37.4	1.2
Ethnic Group	**iTaukei**	534	61.4	-	-	-
	Indo-fijian	325	37.4	-	-	-
	Others	10	1.2	-	-	-
Age group	**Under 19yrs**	115	13.2	13.7	12.3	20.0
	19+ yrs	754	86.8	86.3	87.7	80.0
Division	**Central**	372	42.8	47.9	33.8	60.0
	Western	352	40.5	30.5	57.5	20.0
	Northern	115	13.2	15.9	8.6	20.0
	Eastern	30	3.5	5.6	0	0
				(Under 19yrs)	**(19+ yrs)**	
	Central	372	42.8	52.2	41.4	
	Western	352	40.5	37.4	41.0	
	Northern	115	13.2	8.7	13.9	
	Eastern	30	3.5	1.7	3.7	
				Population %		
				iTaukei	**Indo-fijians**	**Others**
Level of education	**Never**	1	0.1	100.0	0	0
	Primary	128	14.7	53.9	45.3	0.8
	Secondary	537	61.8	65.4	34.1	0.6
	Tertiary	164	18.9	56.1	41.5	2.4
	Currently Secondary	28	3.2	53.6	42.9	3.6
	Currently tertiary	11	1.3	54.5	36.4	9.1
Currently earning some money? Present Occupation	**Yes**	139	16.1	59.7	38.8	1.4
	No	725	83.9	61.8	37.1	1.1
	Legislator	2	1.4	50.0	50.0	0.0
	Professionals	24	17.3	50.0	41.7	8.3
	Technicians	5	3.6	60.0	40.0	0.0
	Clerks	16	11.5	37.5	62.5	0.0
	Service Workers	30	21.6	63.3	36.7	0.0
	Skilled Agr & Fish workers	5	3.6	60.0	40.0	0.0
	Craft&related	12	8.6	58.3	41.7	0.0
	Plant & mach	1	0.7	0.0	100.0	0.0
	Elementary	44	31.7	72.7	27.3	0.0
How many children do you have?	**None**	277	31.9	60.6	37.2	2.2
	1-2 children	313	36.0	58.1	41.2	0.6
	3-4 children	208	23.9	58.7	40.9	0.5
	5-6 children	59	6.8	84.7	13.6	1.7
	>6 children	12	1.4	100.0	0	0
Marital status	**Married**	570	65.6	58.2	41.1	0.7
	Single	272	31.3	68.8	29.0	2.2
	Divorce	7	0.8	57.1	42.9	0.0
	Widow	7	0.8	42.9	57.1	0.0
	Other (defacto& engaged)	13	1.5	61.5	38.5	0.0

Appendix 7: Analysis of Flour Fortification - Awareness, Knowledge, Practice and Behaviour

Questions	Options	Sample Size	All (%of Total)	Population (%)		
				iTaukei	Indo-Fijians	Others
9. Type of flour mostly consumed at home	**Normal**	786	90.4	62.5	36.4	1.1
	Normal & Wholemeal	41	4.7	41.5	56.1	2.4
	Other flour	36	4.1	61.1	38.9	0.0
	Don't know	6	0.7	66.7	33.3	0.0
10. What brand of flour do you normally buy	**FMF**	622	71.6	63.8	35.0	1.1
	Punjas	158	18.2	57.0	42.4	0.6
	Both	73	8.4	54.8	42.5	2.7
	Don't know	16	1.8	43.8	56.3	0.0
11. What determines your choice of flour?	**Price**	331	38.1	75.5	23.6	0.9
	Taste	269	31.0	49.4	50.2	0.4
	Availability	130	15.0	66.2	33.1	0.8
	Brand	64	7.4	43.8	53.1	3.1
	Nutrition	19	2.2	15.8	84.2	0.0
	Other (always buy/use, don't know, texture)	56	6.4	60.7	33.9	5.4
12. Do you read the nutrition label?	**Yes**	214	24.9	46.7	53.3	0.0
	No	613	71.2	67.4	31.3	1.3
	Don't know	34	3.9	47.1	47.1	5.9
13. Have you heard about fortified flour?	**Yes**	78	9.0	56.4	42.3	1.3
	No	785	91.0	61.8	37.1	1.1
14. if yes,what is fortified flour?	**Added iron/nutrients**	42	53.8	35.7	61.9	2.4
	Other (nutritious, healthy, not sure, don't know)	36	46.2	80.6	19.4	0.0
15. Do you know of any health benefits of eating fortified flour?	**Healthy (prevents anaemia,healthy, more energy,provides iron,good blood)**	41	56.2	46.3	51.2	2.4
	Other	32	43.8	65.6	34.4	0.0

Appendix 8: Analysis of Health Information

Questions	Options	Sample Size	All (%of Total)	Population (%)		
				iTaukei	Indo-Fijians	Others
16. In the past 6 months have you taken any nutrient supplements?	**Yes**	140	16.1	42.1	56.4	1.4
	No	729	83.9	65.2	33.7	1.1
17. Which nutrient supplements are you taking?	**Iron & folic tabs**	80	57.1	46.3	51.3	2.5
	Multi-vits	25	17.9	28.0	72.0	0.0
	Folic, Iron & Multi-vits	20	14.3	40.0	60.0	0.0
	Other	15	10.7	46.7	53.3	0.0
18. Did the doctor prescribed the tablets or was it taken on your own initiative?	**Doctor**	105	76.1	44.8	53.3	1.9
	Own	33	23.9	30.3	69.7	0.0
19. How often do you take these tablets?	**Daily**	96	69.6	43.8	54.2	2.1
	Weekly	21	15.2	42.9	57.1	0.0
	Other	21	15.2	28.6	71.4	0.0
20. How long have you been taking this tablet?	**<1month**	45	32.6	55.6	42.2	2.2
	1- <12months	80	58.0	35.0	63.8	1.3
	12+ months	13	9.4	30.8	69.2	0.0
21. When was the most recent deworming tablets taken?	**2010**	275	31.6	73.5 (202)	25.5 (70)	1.1 (3)
	2009	427	49.1	55.0 (235)	43.8 (187)	1.2 (5)
	2008	110	12.7	59.1 (65)	39.1 (43)	1.8 (2)
	Other	57	6.6	56.1 (32)	43.9 (25)	0.0 (0)

Appendix 9: Prevalence of Micronutrient Deficiencies

Characteristics	Groups	Sub-group	Total Sample Size	Hb (<12g/dL)	Ferritin (<15µg/L)	Zinc (<10.1µmol/L)	Folate (<10nmol/L)
1. All	**All**	**All**	**869**	**27.6**	**7.9**	**0**	**1.0**
2. Ethnic Group	**iTaukei**	**All**	**534**	**20.8**	**4.5**	**0**	**1.1**
		< 19yrs	73	13.7	1.4	0	0
		19+ yrs	461	21.9	5.0	0	1.3
	Indofijians	**All**	**325**	**39.7**	**13.8**	**0**	**0.9**
		< 19yrs	40	42.5	12.5	0	0
		19+ yrs	285	39.3	14.0	0	1.1
	Others	**All**	**10**	**0**	**0**	**0**	**0**
		< 19yrs	2	0	0	0	0
		19+ yrs	8	0	0	0	0
3. Age group	Under 19yrs	All	115	23.5	5.2	0	0
	19+ yrs	All	754	28.2	8.4	0	1.2
4. Divisions	**Central**	**All**	**372**	**26.1**	**5.6**	**0**	**1.6**
	-iTaukei	< 19yrs	49	14.3	2.0	0	0
		19+ yrs	207	18.8	2.9	0	1.9
		Sub-total	**256**	**18.0**	**2.7**	**0**	**1.6**
	-Indofijians	< 19yrs	10	60.0	0	0	0
		19+ yrs	100	45.0	14.0	0	2.0
		Sub-total	**110**	**46.4**	**12.7**	**0**	**1.8**
	-Others	< 19yrs	1	0	0	0	0
		19+ yrs	5	0	0	0	0
		Sub-total	**6**	**0**	**0**	**0**	**0**
	Western	**All**	**352**	**30.1**	**12.5**	**0**	**0.3**
	-iTaukei	< 19yrs	14	7.1	0	0	0
		19+ yrs	149	22.8	9.4	0	0
		Sub-total	**163**	**21.5**	**8.6**	**0**	0
	-Indofijians	< 19yrs	29	34.5	17.2	0	0
		19+ yrs	158	38.6	15.8	0	0.6
		Sub-total	**187**	**38.0**	**16.0**	**0**	**0.5**
	-Others	< 19yrs	0	0	0	0	0
		19+ yrs	2	0	0	0	0
		Sub-total	**2**	**0**	**0**	**0**	0
	Northern	**All**	**115**	**27.0**	**2.6**	**0**	0
	-iTaukei	< 19yrs	8	25.0	0	0	0
		19+ yrs	77	28.6	2.6	0	0
		Sub-total	**85**	**28.2**	**2.4**	**0**	**0**
	-Indofijians	< 19yrs	1	100.0	0	0	0
		19+ yrs	27	22.2	3.7	0	0
		Sub-total	**28**	**25.0**	**3.6**	**0**	**0**
	-Others	< 19yrs	1	0	0	0	0
		19+ yrs	1	0	0	0	0
		Sub-total	**2**	**0**	**0**	**0**	**0**
4. Divisions	**Eastern**	**All**	**30**	**20.0**	**3.3**	**0**	**6.7**
	-iTaukei	< 19yrs	2	0	0	0	0
		19+ yrs	28	21.4	3.6	0	7.1
		Sub-total	**30**	**20.0**	**3.3**	**0**	**6.7**
	-Indofijians	< 19yrs	0	0	0	0	0
		19+ yrs	0	0	0	0	0
	-Others	< 19yrs	0	0	0	0	0
		19+ yrs	0	0	0	0	0

Appendix 10: Nutrient Intake by Ethnic Group - 2010 (fortified flour) & 2004 (non fortified flour)

			iTaukei						Indo-fijians						Others						Total					
			2004			2010			2004			2010			2004			2010			2004			2010		
Nutrients	Units	Food Type	N	Median	Mean	N	Median	Mean	N	Median	Mean	N	Median	Mean	N	Median	Mean	N	Median	Mean	N	Median	Mean	N	Median	Mean
Iron	mg/d	Flour products only	496	2.51	3.04	441	13.89	17.48	434	1.36	2.00	309	10.84	12.30	31	2.04	2.88	9	10.91	11.75	961	1.90	2.56	759	12.33	15.30
		Other foods	693	8.27	13.22	534	17.45	24.48	501	6.19	13.30	325	12.16	15.34	36	6.04	11.83	10	16.80	23.60	1230	7.25	13.21	869	15.16	21.05
		All foods	693	10.67	15.39	534	32.07	38.91	501	8.02	15.03	325	23.79	27.04	36	10.19	14.31	10	25.09	34.18	1230	9.26	15.21	869	27.57	34.42
Zinc	mg/d	Flour products only	496	1.13	1.48	441	7.33	9.11	434	1.69	1.59	309	5.63	6.41	31	1.01	1.30	9	5.67	6.16	961	1.34	1.52	759	6.45	7.97
		Other foods	693	6.34	8.92	534	11.95	15.91	501	4.26	5.82	325	7.25	9.03	36	5.27	8.47	10	14.68	15.27	1230	5.39	7.64	869	9.95	13.33
		All foods	693	7.40	9.97	534	19.72	23.44	501	5.96	7.20	325	13.67	15.13	36	7.10	9.59	10	19.37	20.81	1230	6.80	8.83	869	16.87	20.30
Thiamin	mg/d	Flour products only	486	0.31	0.59	441	1.42	1.77	434	0.10	0.38	309	1.08	1.24	31	0.26	0.36	9	1.13	1.20	951	0.21	0.49	759	1.26	1.55
		Other foods	693	0.62	0.99	534	1.26	2.62	501	0.53	1.82	325	0.83	1.24	36	0.54	1.16	10	0.94	1.78	1230	0.58	1.33	869	1.04	2.10
		All foods	693	0.91	1.40	534	2.61	4.08	501	0.73	2.15	325	2.00	2.42	36	0.85	1.47	10	1.99	2.86	1230	0.83	1.71	869	2.33	3.45
Riboflavin	mg/d	Flour products only	486	0.08	0.13	441	0.47	0.59	434	0.04	0.07	309	0.35	0.40	31	0.10	0.18	9	0.36	0.38	951	0.07	0.11	759	0.41	0.51
		Other foods	692	0.63	0.92	534	1.27	1.77	501	0.45	0.80	325	0.95	1.25	35	0.71	1.09	10	2.06	2.44	1228	0.54	0.87	869	1.10	1.58
		All foods	693	0.72	1.01	534	1.72	2.26	501	0.51	0.86	325	1.31	1.64	36	0.85	1.21	10	2.24	2.79	1230	0.62	0.95	869	1.55	2.03
Niacin	mg/d	Flour products only	486	2.40	3.17	441	12.85	16.01	434	0.96	1.78	309	9.91	11.25	31	2.40	2.96	9	9.98	10.66	951	1.67	2.53	759	11.28	14.01
		Other foods	693	14.52	27.33	534	23.13	32.15	501	8.79	13.26	325	13.00	17.87	36	13.97	23.26	10	22.65	25.68	1230	11.50	21.48	869	18.62	26.73
		All foods	693	16.59	29.55	534	36.05	45.37	501	10.50	14.80	325	23.85	28.60	36	17.06	25.81	10	30.32	35.28	1230	13.98	23.43	869	30.89	38.98
Folate	mg/d	Flour products only	350	36.40	41.09	441	305.59	384.55	175	27.60	37.71	309	236.04	267.47	15	43.68	48.45	9	245.88	260.97	541	34.50	44.36	759	271.64	335.42
		Other foods	693	401.56	410.27	534	267.25	352.94	501	284.58	313.32	325	171.86	221.37	36	324.37	355.27	10	94.69	149.56	1230	333.09	369.17	869	221.93	301.39
		All foods	693	428.05	434.34	534	551.60	670.52	501	292.20	326.49	325	416.21	475.72	36	331.78	375.46	10	334.21	384.43	1230	350.65	388.69	869	490.00	594.37

Appendix 11: Percentages of Daily Nutrient Intake Compared to USDA DRI by Ethnic Group - 2010 & 2004

			iTaukei						Indo-fijians						Others						Total					
			2004			2010			2004			2010			2004			2010			2004			2010		
Nutrients	Units	Food Type	N	Below	Above	N	Below	Above	N	Below	Above	N	Below	Above	N	Below	Above	N	Below	Above	N	Below	Above	N	Below	Above
Iron	mg/d	Flour only	499	99.8	0.2	441	62.6	37.4	437	100.0	0.0	309	79.9	20.1	31	100.0	0.0	9	77.8	22.2	967	99.9	0.1	759	69.8	30.2
		All foods	693	78.1	21.9	534	15.9	84.1	501	85.4	14.6	325	29.8	70.2	36	80.6	19.4	10	30.0	70.0	1230	81.1	18.9	869	21.3	78.7
Zinc	mg/d	Flour only	499	99.8	0.2	441	57.8	42.2	437	99.8	0.2	309	72.2	27.8	31	100.0	0.0	9	77.8	22.2	967	99.8	0.2	759	63.9	36.1
		All foods	693	55.0	45.0	534	6.4	93.6	501	70.5	29.5	325	18.2	81.8	36	55.6	44.4	10	0.0	100.0	1230	61.3	38.7	869	10.7	89.3
Thiamin	mg/d	Flour only	489	85.5	14.5	441	38.8	61.2	437	91.1	8.9	309	50.8	49.2	31	100.0	0.0	9	44.4	55.6	957	88.5	11.5	759	43.7	56.3
		All foods	693	59.3	40.7	534	10.9	89.1	501	66.7	33.3	325	14.8	85.2	36	63.9	36.1	10	10.0	90.0	1230	62.4	37.6	869	12.3	87.7
Riboflavin	mg/d	Flour only	489	99.8	0.2	441	89.1	10.9	437	100.0	0.0	309	95.8	4.2	31	100.0	0.0	9	100.0	0.0	957	99.9	0.1	759	92.0	8.0
		All foods	692	68.9	31.1	534	23.8	76.2	501	79.6	20.4	325	37.2	62.8	36	52.8	47.2	10	30.0	70.0	1229	72.8	27.2	869	28.9	71.1
Niacin	mg/d	Flour only	489	99.2	0.8	441	56.2	43.8	437	99.5	0.5	309	71.2	28.8	31	100.0	0.0	9	77.8	22.2	957	99.4	0.6	759	62.6	37.4
		All foods	693	41.1	58.9	534	7.1	92.9	501	63.1	36.9	325	15.7	84.3	36	41.7	58.3	10	0.0	100.0	1230	50.1	49.9	869	10.2	89.8
Folate	mg/d	Flour only	350	100.0	0.0	441	65.5	34.5	186	100.0	0.0	309	81.6	18.4	15	100.0	0.0	9	77.8	22.2	551	100.0	0.0	759	72.2	27.8
		All foods	693	44.9	55.1	534	28.5	71.5	501	73.9	26.1	325	46.5	53.5	36	61.1	38.9	10	70.0	30.0	1230	57.2	42.8	869	35.7	64.3