Safety In Mines Research Advisory Committee (SIMRAC)

Final Report

Nutrition and occupational health and safety in the South African mining industry

Part 1

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Executive Summary

Housing and nutrition have been used as indicators of poverty, and as common targets for intervention to improve public health and reduce health inequalities (Gauldie 1974). The relationship between health, nutrition and housing is well established. The basic human need for shelter and food would appear to make the relationship between poor housing and food, and poor health self evident (Burridge and Omangy, 1993). At the Mine Health and Safety Council meeting in 2001, Mining Occupational Health Advisory Committee (MOHAC) was required to consider the potential impact housing and nutrition has on occupational health and safety in the South African Mining Industry.

Historically, miners have been housed and fed in hostels but provisions of both accommodation and nutrition are changing and vary across the industry. There is no recent research to assess whether miners are receiving the proper nutrition and fluid intake for the physical demands of the work they perform in the South African mining industry. Research is therefore needed to assess the nutritional status of mineworkers who live out and those who stay in the hostels and to provide guidelines for a nutritionally adequate diet for mineworkers in various mining environments.

The Black labour law was the last law to regulate nutrition in the mines. The regulation was gazetted in 1975 and stipulated the minimum ration scale for "Bantu" employees. Since 1988, there have been no regulations or standards sets for the mining community. The Mine Health and Safety Act 1996 (Chapter 8) states that the Minister, after consulting the council, may make regulations regarding the standards of housing and nutrition of employees who are accommodated at a mine.

The objectives of the nutrition component of the study were to;

- conduct and document a critical analysis of the latest information on the effects of nutrition on the health and safety of mineworkers;

- review the history of the statutory regulations on nutrition of employees who live on the mines;

- conduct a pilot study with the following aims:
    - evaluate the nutritional content of daily food rations and fluid intake provided to mineworkers living in hostels and miners living out of hostels
    - evaluate the knowledge, attitudes, experiences and perceptions of mineworkers and managers with respect to health and nutrition;
    - provide a baseline and develop indicators for future evaluation of nutrition; and
- draw up a report with recommendations to the Mining Occupational Health Advisory Committee (MOHAC) for policy development and to SIMRAC for research.

The nutrition and housing project was conducted at the same mines but by two different organisations at different times. The nutrition project covered five additional mines, which included opencast mines.

Both the overweight and the underweight suffer from malnutrition; a deficiency or excess in a person's intake of nutrients and other dietary elements needed for healthy living are both associated with high levels of sickness and disability, shortened life expectancies, and lower levels of productivity. The importance of nutrition as a contributing factor to absenteeism, physical efficiency, and proneness to injuries is well recognised in the scientific literature. However, from the literature search conducted in the study, it is evident that the association between nutrition and occupational health in terms of diseases is not as clear. Tuberculosis (TB) is the only obvious exception. In many of the studies reviewed, a decrease in the number of occupational diseases was associated with improved working conditions, which included improved nutrition.

Ten mines representative of all commodities in the South African mining industry were selected as the sample for the study. A total of 497 mineworkers were interviewed. Fifty-seven percent of these were non-hostel dwellers and 43% were mineworkers who stayed in a hostel.

Non-hostel dwellers spent between R570 and R2 303 per month on food, transport and accommodation, which was between 20% and 59% of their salary. Hostel dwellers spent approximately half that amount i.e. between R214 and R1 068 on food, accommodation and/or transport, which was about 7% to 21% of their salary.

Approximately 5% of the hostel dwellers interviewed reported that they never ate at the hostel kitchen, 15% ate only one meal per day, 55% ate two meals per day, and 26.4% ate all three meals at the hostel kitchen. Although preparing food in hostel rooms was strictly prohibited, except at one of the gold mines, 64% of the hostel dwellers admitted to this practice.

Forty-one percent of non-hostel dwellers reported that they never ate before going to work while 73.5% of hostel dwellers reported that they always ate or drank something before they went to work. Fifty-seven percent of non-hostel dwellers always took something to eat to work as opposed to 38% of hostel dwellers. Only 23% of non-hostel dwellers reported getting hungry during a shift as opposed to 36% of hostel dwellers.

Generally, 814 ml of fluid was consumed on an average shift by the mineworkers participating in the study. An average of 43% of the total study population did not take anything to eat to work. This was particularly seen in the 'dusty, dirty mines', i.e. 77% of the mineworkers at the Platinum Mine, 68% of mineworkers at the gold mines and 56% of mineworkers at the coal mines did not take food underground.

The main reasons given for not eating were that:

- the participants were not in the habit of taking food to work;
- they did not have the time to eat;
- they had insufficient resources, either money or food;
- working conditions were not conducive to food being stored or eaten; and
- they did not have sufficient time to prepare food to take underground.

Mineworkers felt that the food they were eating enabled them to do their work well, with 91% expressing the belief that they were eating the correct food. However, only 82% of hostel dwellers, as opposed to 98.5% of the non-hostel dwellers, felt that they were eating correctly and this is probably because the hostel dwellers were not happy with food served by the hostel kitchens.

Fifty-one percent of hostel dwellers, as compared to 23% of non-hostel dwellers, claimed that it was difficult to gain access to food when they were hungry. The main reason given by the hostel dwellers was that the mineworkers did not take food to work. Other reasons given were that there were no food outlets or canteens available at work, or that they did not have enough money to buy extra food. Some of the hostel dwellers complained that the canteen was closed at night or that certain kinds of food were usually finished by the time they got back from their shift.

It became evident from the start of the study that the majority of hostel dwellers were very disappointed with the food served at all the hostel kitchens investigated. The main concerns of the hostel dwellers were:

- the way food was prepared;
- the lack of training of the kitchen staff;
- the lack of fresh food;
- the lack of variety of food;
- certain items on the menu (usually vegetables and fruit) would be finished if mineworkers were delayed underground;
- the food committee did not take their suggestions seriously

Evaluation (by 24-hour recall method) of the reported energy and macronutrient intakes of mineworkers showed that their energy intakes were generally low. The mean energy intake was 8014 kJ, which was between 30-44% less than expected. The average recommended energy intake (REI) for light to moderate classes of activity for the study population was 11 431 kJ and for heavy activity was 14 289 kJ. However, the findings of low-energy intakes could be a reflection of the limitations of the 24-hour recall method used for the collection of dietary-intake data in this study. The 24-hour recall method is known to underreport dietary intake. In the European Prospective Investigation into Cancer and Nutrition Study (EPIC), 13.8% of women and 10.3% of men were identified as extreme under-reporters (Ferrari et al., 2002). A study done in Sweden showed that the prevalence of under-reporting in men was as high as 61% when repeated 24-hour dietary recalls

were used (Johansson *et al*. 2001). Macronutrient intakes were in line with the recommendations for a healthy diet, but there are indications that low fat intakes may be a problem at some mines. Very low fat diets may result in an inadequate intake of essential fatty acids, which are important for maintaining the structure and function of the cell membranes.

Micronutrient intakes were generally low, and of special concern were the very low intakes of vitamins A and C. Both of these vitamins play an important role in resistance to infection, while vitamin A is important for seeing in the dark, which may be especially important for mineworkers.

There are indications that the dietary intakes of mineworkers living outside the hostels were more favourable than those of workers living in the hostels. Analyses of the 24-hour dietary recall data showed that mineworkers who lived outside the hostels had significantly higher energy, total fat, dietary cholesterol and total carbohydrate intakes. Vitamin A and vitamin C intakes were also higher for those living outside, although in both groups mean intakes were low. While the difference in mean energy intakes seems small, the deficiency in micronutrient intakes, especially vitamin A and vitamin C, are of concern and need attention. The low intakes of vitamins A and C are probably the result of inadequate intakes of vegetables and fruit by both hostel dwellers and non-hostel dwellers.

The mean body mass index (BMI) values for the different mines fell into the "normal weight" category, the exceptions being the Diamond Mine and the Platinum Mine groups, which were considered to be overweight. The average BMI values for hostel dwellers and non-hostel dwellers were very similar at 25.1 and 25.6, respectively.

At the mines with hostels, hostel dwellers were 1.35 times more likely to have had tuberculosis (TB) than non-hostel dwellers ($p<0.04$). At the mines with no hostels, 4.8% of the study participants had had TB. Hostel dwellers seemed to be less well off than non-hostel dwellers, not only in terms of their diet but also in matters of health, such as their greater chance of contracting TB. Diet may play a role in the difference in the prevalence of TB, although it would only be a contributing factor. The intakes of vitamins C and A were significantly lower in the hostel dwellers than in the non-hostel dwellers. As mentioned previously, vitamin C and vitamin A both play an important role in resistance to infection. Vitamin C increases immunity (Balch, et al., 2000). Ascorbic acid appears to stimulate humoral immunity through

increased antibody synthesis particularly IgG, IgA and IgM types and also by activating the macrophages (Ansari et al., 1998).

Aids/HIV-induced malnutrition has been associated with the disease from its early stages. In these patients, protein energy malnutrition (PEM) arises from a markedly decreased nutrient intake or nutrient assimilation, due to disease-induced loss of appetite, malabsorption or drug nutrient interactions as well as infections, malignancy or endocrine dysfunction (Gray, 1983). Irrespective of the process(es) involved, the micronutrient deficiencies are known to impair immune function (Chandra RK, 1983).

Hostel dwellers were 1.6 times more likely to have received compensation for an injury than non-hostel dwellers at the mines with hostels, although this was not statistically significant (p=0.1). At the mines with no hostels, 18,5% of the study participants received compensation for an injury at work. At the mines with hostels, the percentage of hostel dwellers receiving compensation for an injury at work was 20.1% compared to 13.4% of non-hostel dwellers. The accident statistics received from the mines for the year 2002, showed that a large percentage of the accidents at the mines occurred early in the week (around Tuesday) and then again just before the weekend. Most of the accidents occurred during the first part of the day shift between 8h00 and 13h00. There are several factors that could be responsible for the occurrence of accidents during a specific day or time of day, for example, there may be a greater number of workers on the day shift than on the night shift; also most maintenance occurs during the day. The design of the study did not allow for direct correlation between dietary intake and injury, the fact that such a large percentage of workers did not eat breakfast is of concern

Of the seven hostel kitchens surveyed, five mines provided the kitchen staff and facilities while two kitchens had been sub-contracted to private companies. The daily strength at the kitchen varied from 50 to 4 975 mineworkers for breakfast and from 200 to 5 981 for the main meal. Only one of the hostel kitchens provided a third meal; the rest provided breakfast and a main meal. The cost of meals ranged from R5.00 to R9.63. Only one kitchen (at the iron mine) provided food packs for mineworkers to take to work. At the platinum mine, fortified mageu was given to the mineworkers at the shaft. At the gold mines, food was provided and prepared for diabetic mineworkers, and at the Platinum Mine, advice about nutrition was given to diabetic mineworkers.

All kitchens ran 24 hours a day and were open to the mineworkers in the morning, most of the afternoon and into the late evening, seven days a week, including public holidays. Most kitchens made use of a system where mineworkers presented their ID cards to gain access to the kitchen or/and to obtain a protein serving. Five of the hostel kitchens provided food only for hostel dwellers, whereas at the other kitchens all mine employees had access to the food produced by the kitchen. The survey found that most of the hostel kitchen staff had received little or no training, except at the kitchens where a consulting dietician (at the Platinum Mine and at Gold Mine 2) or full-time food service manager (at Gold Mine 2) were available. Most of the hostel kitchens followed a ration scale, especially for meat.

Most hostel kitchens had a feeding committee, which consisted of the hostel manager and union representative and appointed hostel dwellers. Regular internal health and safety "audits" were conducted at all the kitchens visited and the kitchen staff was regularly sent for medical surveillance. However, only one hostel kitchen had a kitchen policy. Management should define and document a kitchen policy, objectives and commitment concerning hostel feeding and nutrition. Management should ensure that the kitchen policy is understood, implemented and maintained.

Observed food storage and preparation at all hostel kitchens were good. All hostel kitchens had dining-hall facilities. At two hostels it was compulsory for mineworkers to eat at the dining-hall and food was not allowed out of the dining-hall. Better control over food wastage and general hygiene was observed as the amount and type of food not consumed was monitored and plates were washed at the kitchen.

The plate survey done at each hostel kitchen highlighted the variability in servings and portion sizes given to the mineworkers.

The telephone survey conducted in part 2 of the nutrition and housing and occupational health and safety report (see Section 3.1) asked managers at 102 underground mines about their canteens and midshift feeding. Sixty mines had mass catering canteens. This left 42 mines that did not. The vast majority of both permanent and contract workers are permitted to take food underground on their shift, leaving only 6% of permanent workers and 2.3% of contractors who are not. Respondents reported that 80.9% of all permanent workers and about 70% of contractors at 84 mines were provided with food by the mine to take underground, but this may refer to liquid food supplement only. Ninety-four mines responded as to whether they had special underground eating areas at the mine. Sixty-six of

them, responded that they had such areas, leaving 28 mines that did not.

Although 92.7% of all permanent workers at 95 mines that responded reported that they had underground mid-shift meal breaks as required by law, 7.1% of permanent mineworkers and 11.9% of contractors in 95 of the survey mines were working in gold mines where they had no meal break during the underground shift. The mean duration of the meal break for all mines in the survey was 30 minutes.

On the basis of the results of this study, the following recommendations on nutrition are proposed:

- Food-Based Dietary Guidelines for the mining Industry
- Nutrition and hydration during physical work in heat
- Hydration and nutrition before, during and after work
- Education
- Food Fortification
- The need for appropriate supervision in Hostel Kitchens
- Cooks
- Batch Cooking
- Food wastage/Disapproval
- Food Purchasing
- Storage
- Organisation of food issues
- Food being thrown away or consumed by persons not employed by the mines
- Further research

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Glossary

Ascorbic acid

A vitamin i.e. vitamin C found in fresh fruits (especially citrus fruits) and vegetables; prevents scurvy

Basal metabolism

The amount of energy required to maintain the body of an individual in a resting state

Body mass index (BMI)

Is calculated from your weight and height and is used to show how weight compares to others of the same height. Body Mass Index can be used to indicate if you are overweight or normal

Body cell mass (BCM)

BCM is the functional mass of the body involved in work and represents the metabolically active component of the body.

Calories

Used by nutritionists to characterise the energy-producing potential in food

Carbohydrates

An essential structural component of living cells and source of energy for animals; includes simple sugars with small molecules as well as macromolecular substances

Daily strength

The expected number of mineworkers to be served at the hostel kitchen per meal

Dehydration

Depletion of body fluids

Dietary Reference Values (DRVs)

The expert Working Groups set up by the Committee on Medical Aspects of Food Policy (COMA) in 1987 initially reviewed published Recommended Daily Intakes (RDI) (1) and Recommended Daily Amounts (RDA) (2) in 1969 and 1979 respectively and in 1991 produced its guidelines on DRV's which were more comprehensive and set a range of values

Euhydration

Normal state of body water content; absence of absolute or relative hydration or dehydration

Fat

A soft greasy substance occurring in organic tissue and consisting of a mixture of lipids (mostly triglycerides)

Food service manager

Technical qualified person in food management

Kilojoules (kJ)

Used by nutritionists to characterise the energy-producing potential in food

Mageu

A fermented maize drink made with maize, flour and water.

Metabolic rate

Rate of metabolism; the amount of energy expended in a given period

Mealie

Maize has long been the basis of African cuisine. Each community, whether Xhosa or Zulu, Sotho, Tswana or Swazi, holds to slight differences in making it and preferences in eating it, but certain dishes have the approval of nearly all

Mealie-meal / pap / maize-meal

Dried maize kernels ground fine into maize-meal or mealie-meal

Morogo

Any green leaves, including bean and beetroot leaves

Protein

Any of a large group of nitrogenous organic compounds that are essential constituents of living cells; consist of polymers of amino acids; essential in the diet of animal for growth and for repair of tissues; can be obtained from meat and eggs and milk and legumes

Recommended dietary allowances (RDA)

The average amount of a nutrient, which should be provided per head to a group of people if the needs of practically all members of the group are to be met (Average for a group)

Reference Nutrient Intakes (RNIs)

The amount of a nutrient (EAR + 2 Standard deviations) which is sufficient for almost all individuals (97.5%). It by definition exceeds the requirement of most people and habitual intakes above RNI are almost certainly adequate.

Samp

Broken/dried maize kernels, sometimes cooked plain or with beans

Sorghum beer

Maize mixed with sorghum and yeast

VO2 max i.e. maximum oxygen consumption

Maximal rate of oxygen consumption is a measure of the body's capacity to generate the energy required for endurance activities and is one of the most important factors determining the ability to exercise for longer than four to five minutes

1. Introduction

Inadequate nutrition of mineworkers to meet physical and cognitive demands of mining tasks may potentially lead to health disorders and unsafe work practices. This situation is aggravated in the presence of chronic disease. Historically, miners have been housed and fed in hostels but provision of both accommodation and nutrition are changing and vary across the industry. There is no recent research to assess whether miners are receiving the proper nutrition and fluid intake for the physical demands of the work they perform in the South African mining industry. Research is therefore needed to assess the nutritional status of mineworkers living out of and staying in the hostels to provide guidelines for a nutritionally adequate diet for mineworkers in various mining environments.

1.1 Study objectives

This research had the following objectives:

1.2.1 to conduct and document a critical analysis of the latest information on the effects of nutrition on the health and safety of mineworkers;

1.2.2 to review the history of the statutory regulations of nutrition of employees who live on the mines;

1.2.3 to conduct a pilot study with the aim of:

- evaluating the nutritional content of daily food rations and fluid intake provided to mineworkers living in hostels (miners who provide their own food were also assessed);
- evaluating the knowledge, attitudes, experiences and perceptions of mineworkers and managers with respect to health and nutrition;
  providing a baseline and developing indicators for future evaluation of nutrition; and

1.2.4 to make recommendations to the Mining Occupational Health Advisory Committee (MOHAC) for policy development and to SIMRAC for research.

The project leader reported monthly to MOHAC on the progress and findings of the housing and nutrition study during the study period. Additional objectives were requested:

- Average expenditure on food as a proportion of the salary
- Average salary of study sample interviewed
- TB and occupational injuries statistics

2. Literature review

As a first step to achieving the objectives of the study, a literature review was conducted, focused primarily on nutrition in the mining industry, nutritional physiology, food-based dietary intakes for South Africa, nutrition and occupational health and safety, nutrition and illness and finally food fortification. The dietary principles discussed in this section of the research report are drawn from relevant sports science research, studies conducted on mineworkers and military personnel. The importance of good nutrition and the positive effect it has on athletic performance are widely accepted (Brooks, et al., 1994; Below et al., 1995; Goedecke et al., 1999) and can be generalised to the activities of mineworkers.

2.1 Historical background

2.1 .1 Diet and food preparations for mineworkers

Since 1886, the Bantu labourers were housed and fed by the mining companies. A significant proportion of the capital costs were spent on providing housing, sanitary facilities, hospitals and first aid stations, and on kitchens and breweries. The objective of mine feeding was a short-term one aimed at maintaining the working adult in a physically fit state. He arrived fully-grown and stayed only for comparatively short periods.

The industry depended on a migratory system, and employment offered was popular amongst the tribal Bantu of Southern Africa. About 30% of the total labour force employed in 1946 was foreign. About 60% of the labour force fell into the age group 18 to 28 years; 20% in the age group 29 to 34 years and 20% in the group 35 to 41; only a few remained to work after attaining 41 years of age. The average age of labourers from the Cape Province was 27.8 years.

Dr Schultz (1958), former Foods Inspector to Johannesburg Consolidated Investment Co. Ltd. made the following comment,

> "The heavy work required when a labourer is employed in mining, calls for increased metabolism involving a diet of greater caloric value than that consumed at home, and there must be an assured source of the essential vitamins to protect the individual against the deficiency diseases. With an adequate diet comes a fall in sickness rates and consequent saving of economic loss due to hospitalisation, and contentment of the labour force with less accidents and a higher output of work."

E. W. Granger, a veteran manager of mine labour, recalled that in the early days the diet consisted mainly of carbohydrates derived from maize with some inferior meat. Occasionally beans and vegetables were served. In the South African Medical Records for 1903, Dr Klein stated that the diet was responsible for the high death rate on the mines, which sometimes was as high as 90 per 1000. A memorandum issued by the Chamber of Mines in that year gave the number of deaths from scurvy over the period November 1902 – April 1903 as double those due to accidents.

Schultz (1958) commented that not sufficient was known about the African metabolism and eating habits. He made the following observations:

- The African diet was monotonous. Yet at home the African had a remarkable number of ways of preparing food with the limited number of foodstuffs forming his staple diet.
- The Xhosa do not like vegetables, thinking that such foods are fit only for women and children. A diet considered fit for these men were meat and beer.
- Africans lived increasingly on maize products with a decreased consumption of milk and meat.
- The intake of fruit and vegetables was scanty being influenced by tribal customs which contrasted with some of the tribes living outside the Union of South Africa on the East Coast where vegetables and especially fruit formed an important part of their diet.

Communal feeding of a mixed labour force drawn from different tribes with diverse eating habits and food prejudice was no simple matter. Difficulties were

experienced particularly in standardising the diet, determining the amount of food to be issued, and introducing new types of food and methods of preparation.

2.1.2 Statutory regulation

A review of the reports and events concerning nutrition in the mining industry is of interest in order to assess nutrition in the mining industry currently. For convenience the events have been looked at in chronological order.

1889

The first published report dealt with the threat of severe food shortages (Flemming et al., 1966). Stocks of food in some of the mining camps in the Transvaal were inadequate. Following a special commission an urgent appeal was made to the Government for the lifting of special duties on mealie meal, flour, butter and tinned foods. Five thousand pounds was provided for the relief of distress. Assistance was also received from the Natal and Cape Governments in terms of a reduction of railway rates for cereals in transit.

1896

In this year, the frst regulation for the feeding of "Bantu" in compounds was promulgated. These regulations provided for a maximum allowance of 17.5 lbs of mealie meal and 2 lbs of meat per labourer per week.

1899

The Medical Plague Officer (Fox, 1940) addressed a letter to the Secretary of Mines advocating anti-scurvy measures such as the use of fresh South African mealies rather than dried, imported mealies. He also advocated the adoption of adjuncts such as vegetables, fresh meat, and lime juice and the avoidance of alcohol.

1902

The Native Affairs Department assumed control over the Bantu employed on the mines and inspectors were sent out to implement the system of inspection. One of

the functions of the inspectors was to visit the compound hospitals and kitchens and generally to enquire into all matters affecting Native employees.

1903

A conference was called by the Commissioner of Native Affairs, Sir Godfry Lagden, which was attended by representatives of the Chamber of Mines and Mine Medical Doctors. Arising from this, a six-member committee of mine doctors (The Macaulay and Irvine Commission) investigated the health and diet of mine Bantu. They submitted their recommendations on a diet to the Commissioner.

Dr M.M. Blaney gave evidence before the Committee of Native Affairs. His criticism of the existing diet for Bantu labourers was that it lacked fat, contained too great a quantity of mealie meal (2 lbs per labourer per day) and that nitrogen was wanting on the non-meat ration days (3 lbs of meat was issued and divided between three out of the seven days of the week). He subsequently read a paper entitled "Foods and the Practical aspects of Some Compound Work" (1905) at the general meeting of the South African Association of Engineers.

The committee then submitted to the Commissioner of Native Affairs a report, which outlined certain recommendations for a Bantu diet. These were eventually outlined in the government minimum requirements for Bantu labourers, and published in the Government Gazette of 1911.

1910

The Mining Regulations Commission was appointed under Government Notice No. 537 of 1907. Evidence was heard from Dr G A Turner, Medical Officer of the Witwatersrand Native Labour Association, on the advisability of giving liquor to Bantu people, and on the correct diet for Bantu labourers. Further evidence from Dr M M Klein, Medical Officer Apex Mine and Rand Collieries, indicated that fat in the diet had been underestimated and carbohydrates overestimated. Dr Klein suggested reducing the allowance of mealie meal and substituting it with peas, beans, rice, etc. To avoid monotony, he advocated the introduction of fresh vegetables.

Mr P Snowdon (Snowdon, 1910), in a paper entitled "An Economic Aspect of Mine Labour as Employed on the Witwatersrand Mines", pointed out the need for pre-

shift feeding and referred to the recommendations made by the Macaulay and Irvine Commission of 1903. Reference was also made to the unsatisfactory state of food preparation in compounds and the need for better care of workers to promote labour efficiency.

The Mining Regulations Commission, with Judge Krause as chairman (Porter and Heyman, vol 1, p. 73 (s.a.), discussed the relative quantities of different diets. They mentioned that the gravest defect in the official diet was the assumption that 2 lbs of mealies were issued to each labourer and actually consumed by him. They also recommended an increase in the quantity of vegetables and an issue of peanuts and bread. While agreeing that the original ration of 2 lbs (907 g) of mealie meal per day was too large, they considered the amount of 14 oz (400 g) too low, and accepted the value of 20 oz (567 g) recommended by Drs Turner and Irvine.

1912

A prolonged drought led to the anticipation of a short supply of maize. A request to government for the temporary suspension of import duty on maize and for a reduction of railway tariffs for the product was denied.

Dr Loeser (Loeser, 1912) describes the diet of mine Bantu in his article: "A fascinating summary of the types of food and form of their preparation by different Bantu tribes in their rural state". He set forth considerations, which he believed should be employed in planning a common diet for labourers removed to large centres for labour.

1914

The Surgeon General of the U.S.A., and Chief Sanitary Officer of the Isthmian Canal Commission, was consulted for his opinion of the system of rations for Bantu mine labourers. He was surprised at the quantity of mealie meal issued (2 lbs per labourer per day). He felt it was too much and suggested it be reduced and other commodities substituted for it. He commented favourably on the feeding scheme practised in Kimberley, where the labourers received cash in lieu of food and where each was responsible for his own food.

1921

There were a number of subsequent government notices. Annexure B, the Native Labour Regulation Act, 1911 was amended by Notice No. 2241, dated 8 December 1920. The chief changes included:

- Mealie meal 20 oz to 24 oz / day
- Bread 6 oz to 8 oz / day
- Meat 3 lbs to 3.75 lbs / day
- Dried beans 4 oz to 3 oz / day
- Peanuts 2 oz / day
- Sugar 1 oz / day
- Salt "sufficient"
- Vegetables 5 oz / day
- Coffee or cocoa 0.2 oz / day

A further notice, No. 37, dated 5 January 1922, Annexure B, allowed the substitution of one ounce of whole mealies, samp, or approved cereal for an ounce of beans. Government Notices No. 326/1937 and No. 6164/1959 were subsequently passed but contained no alteration to the rations stipulated in 1922.

The mining industry subsidised an investigation by S.A.I.M.R. (Delf, 1921) on the anti-scorbutic properties of certain South African foods. The S.A.I.M.R. findings were presented in a report.

1931

A decrease in susceptibility to sickness was ascribed to the administration of vitamins and pre-shift feeding (Scholtz, 1931).

1938

The Nyasaland[1] Royal Commission commented on the improvement in the health of Bantu labourers, following a period of employment on the mines. Comparisons of weights on engagement and on return to Nyasaland showed that 92% of the

[1] Now Malawi.

labourers had made an average gain of 10 lbs. This was attributed to good food on the mines.

1941

A system of food rationing and waste control was initiated in the Goldfields Group by Dr. L S Williams (Williams, 1942). This was later published by the Mine Medical Officers Association. The diet of the average labourer was considerably enriched by this method, but a strict control was exercised over wastage of compound food.

Following the Lansdown Commission of 1943 (Goode, 1952) in which the policy of pre-shift meals was advocated, Goode and Talbot (1952/3) of the Union Corporation introduced both pre- and mid-shift feeding experimentally, and described these as being both popular and economical.

1958

The Nutrition Division of the Applied Physiology Laboratory of the Chamber of Mines made a start on the analysis of the quantities of food issued to mine labourers.

1959

Fox (1959) drew attention to the inflexibility of the Government Act, which had not been amended since 1922, and suggested that in the light of changing concepts of nutrition, the diet of the mine Bantu be reassessed (Fox, 1959).

1960 – 1961

A statistical examination of the diet of the population of non-privileged labourers of seven gold mining companies was carried out for a 51-week year (Fleming, 1966a).

1964 – 1988

The Black/Bantu Labour Law was the last law to regulate nutrition in the mines. The regulation was gazetted in 1975 and stipulated the minimum daily ration scale for Bantu employees. Items mentioned in the regulation were as follows.

Cereal (560 g)

Cereal included flour or commercial powder for mageu, Bantu beer and similar liquor, mealie meal, whole mealies, mealie rice, samp, bread meal, barley, home made noodles, macaroni, soup thickening agents, etc. Should the Director of Bantu Labour, after consultation with the medical officer, deem it desirable, he could reduce the ration scale so that it conformed to actual calorie requirements. It was recommended that mealie meal and its substitutes should be freely available, but that the quantities be adjusted to meet the requirements and prevent wastage.

Bread (125 g)

Bread could be substituted with any of the cereals. Bread had to meet the specifications laid down by the Wheat Industry Control Board, namely that compound bread was baked only from sifted meal, and that only yeast, water, salt, vinegar and calcium acetate could be added to it.

Beans (50 g)

Beans could be substituted with peas, lentils, soya beans, or fat free soya products. Only beans of good quality could be used.

Fresh meat (170 g)

Fresh meat included beef, mutton, pork, chicken, or venison, dressed, containing not more than 25% of bone. The above could be substituted with:

- fresh fish (170 g) OR
- meat not containing bone or canned fish / meat (130g) OR
- fat free soya products (50 g).

PLUS

- oil (10 g) OR
- cereal (25 g) OR
- eggs in the shell (150 g) OR
- egg powder (40 g) OR
- cheese (70 g) OR
- fresh milk (700 ml) OR
- milk powder (70 g) OR
- shelled peanuts (60 g) OR
- beans (75 g).

Any of the meat substitutes could have, in the given quantities, replaced this item completely. In practice, however, it was not possible in the case of items such as beans because the total quantity of beans as given in the ration scale was too much to use. A combination of two or more of the substitutes in the correct proportions was, however, possible. For example, a combination of 85 g of meat or fish and 35 g of beans makes an acceptable and nourishing ration.

Offal (50 g)

Offal could be substituted for meat containing about 50% bone.

Fat (15 g)

Fat included suet, mutton fat lard, chicken and vegetable fat. The use of oil was encouraged because it contains important unsaturated fats.

Fresh vegetables (140 g)

Vegetables had to be fresh and had to come with their leaves and peels, except carrot leaves (which were considered dangerous) and maize leaves (which are inedible). Fresh vegetables could be substituted with:

- dehydrated vegetables (15 g) OR
- canned vegetables (140 g) OR
- frozen vegetables (140 g) OR
- fresh fruit (140 g).

To prevent the loss of ascorbic acid, vegetables were, as far as possible, to be prepared unpeeled (the leaves to be used). Cleaned and cut vegetables were cooked immediately. Vegetables were only to be cooked until they were ready and had to be served as soon as possible thereafter. They were minced and stirred raw into a stew or soup just before it was served. If possible vegetables such as tomatoes were to be served raw. It was also recommended that fresh fruit in season, especially oranges, were to be eaten as frequently as possible. It was important that when dehydrated vegetables were used the full mass was supplied.

Sugar (30 g) per day per mineworker

Milk (50 ml)

Milk included fresh milk, whole-milk or skim-milk. Milk could be substituted with whole-milk powder (5 g) OR skim-milk powder (5 g).

Salt and herbs as required

Tea, coffee and cocoa

Cocoa issued contained not less than 25% of cocoa fat, and coffee was not to contain less than 75% of pure coffee, the remainder being pure chicory. Tea had to be of good quality.

Mageu

If any of the foods set out in the minimum ration scale were unavailable, sufficient and suitable substitutes had to be issued. All vessels and utensils used in brewing or storing of mageu had to be of acid-proof and hygienic materials, such as stainless steel or plastic glass fibre. The enrichment of mageu with ascorbic acid was strongly recommended, especially when fresh fruit was not supplied regularly.

AFTER 1988

The Black/Bantu Labour Law was repealed by 1988. Since 1988, there have been no regulations or standards for the mining community. However, in the Mines Health and Safety Act of 1996, there is provision made for a regulation on nutrition.

2.2 Nutrition

2.2.1 Introduction

Over the past 20 years, research has clearly documented the beneficial effects of nutrition on exercise performance. There is no doubt that what an athlete eats and drinks can affect health, body weight and composition, substrate availability during exercise, recovery time after exercise, and ultimately, exercise performance. The studies on the effects of long-term underfeeding consistently demonstrates that underfeeding if conducted long enough can have detrimental effects on soldier physical performance capability (Montain, et al., 2002). Reductions in work productivity have also been reported in underfed non-military labourers such as

coal miners (Keller, et al., 1963), and German industrial workers (Kraut, et al., 1946).

If the research by Lambert, et al. (1994) is an accurate reflection of energy intakes of manual workers in South Africa, energy deficits are likely to result in the early onset of fatigue. Energy intakes of elderly black and coloured South Africans from informal and formal peri-urban settlements are reported to be below the recommended dietary allowance (RDA) for both men and women (Charlton, et al., 1997; Charlton, et al., 2001). Urbanisation has created a further concern in that carbohydrate (CHO) intake in the more affluent sectors of the population has decreased while fat intake has increased (Bourne, et al., 2002). Among rural African dwellers, similar shifts towards this western diet are also apparent (Bourne, et al., 2002). This is likely to result in increased incidence of coronary heart disease in the future.

One of the difficulties in interpreting the observations regarding diet and physical performance is that different performance tests have been used in the various studies. Researchers typically quantify physical performance by measuring muscle strength, muscle power and or anaerobic power and aerobic capacity. Such performance tasks do not necessarily measure performance ability relevant for occupational relevant tasks. Unfortunately, field tests and occupationally relevant tasks are not without their own limitations. For example, changes in ambient temperature can influence motivation to perform and compromise aerobic capacity independent of diet. Similarly if the task is novel, there may be a large inter-subject and intra-subject variability that will compromise the ability to detect modest differences associated with dietary intervention with small sample sizes (Montain, et al., 2002).

2.2.2 Energy

Energy balance is defined as a state when energy intake (the sum of energy from food, fluids, and supplement products) equals energy expenditure (the sum of energy expended as basal metabolism, the thermic effect of food, and any voluntary physical activity) (Swinburn, et al., 1993). Energy expenditure is influenced by heredity, age, gender, body size, fat free mass, incentives to work/compete and intensity, frequency and duration of work.

In 1989 Recommended Dietary Allowances (RDAs) (National Research Council, 1989) mean energy requirements for women and men who are slightly to moderately active and between 19 to 50 years of age were established as 9211 and 12140 kJ per day respectively.

Low-energy intakes can result in loss of muscle mass, menstrual dysfunction, loss or failure to gain bone density, and increased risk of fatigue, injury, and illness. Inadequate energy intakes relative to energy expenditure compromises performance. With a very limited energy intake, the fat and lean tissue mass will be used by the body for fuel. Loss of muscle results in the loss of strength and endurance.

Several kinds of prolonged exercise, such as cycling, hill walking and military manoeuvres, induce a negative energy balance because of energy intake being lower than expenditure. From studies conducted (Dohm, et al.., 1986; Loyd, et al., 1986 and Greenson, et al.., 1988) it appears that short-term fasting reduces physical performance and modifies metabolic responses to exercise. Furthermore, there is increasing evidence that a negative energy balance may have several adverse effects on health, e.g., on the immune system (Chandra, R.K., 1990) as well as on sex hormones and bone mineralisation (Calloway, 1987 and Santora, 1987).

2.2.3 Carbohydrates

The human body operates most efficiently when carbohydrates are used as a substrate for energy. Carbohydrates are the most readily available and also the preferred fuel for energy. Carbohydrates are stored in the body as glycogen, mainly in muscle tissue, while a small amount is also stored in the liver. When working at a moderate to heavy intensity, a person uses 70% of his fuel for energy from carbohydrates and 30 percent from fats (Benade et al.., 1973). Stores of carbohydrates are limited. With prolonged exercise, more and more fat is used and less of the carbohydrates are utilised until the initial position is reversed. This occurs after four to six hours of moderate work. The higher the work intensity, the sooner the carbohydrate stores will deplete and consequently the higher the body's dependence on fat metabolism. Numerous authors have shown that a depletion of

muscle glycogen coincides with the onset of fatigue. For example, Sherman and Lamb (1988) estimate that if carbohydrates were the only energy source for exercise at a moderate intensity, carbohydrate oxidation would support the energy demands of exercise for about two hours. It is obvious that this is insufficient to sustain most mining activities, which continue for eight- to twelve-hour periods, sometimes with little or no fuel replenishment.

Ingestion of CHO during physical activity is important to maintain optimal blood glucose levels and spare liver glycogen (Bosch, et al., 1993), thereby preventing hypoglycaemia during prolonged activities. However, while CHO ingestion during exercise spares liver glycogen, it does not alter the rate of muscle glycogen depletion, hence the importance of a high habitual daily dietary CHO intake (7-10 g/kg body mass).

Dismounted soldiers performing military training, are well known to drink insufficient fluid to maintain euhydration and consume insufficient food to maintain energy balance (Armstrong, 1994; Jones, et al., 1990; Roberts, et al., 1987 and Strydom, et al., 1968). This problem is exacerbated in hot climates and high altitude (Herman, 1993 and Hoyt, et al., 1996). Montain, Shippee and Tharion (1997) performed a study to directly test whether provision of carbohydrate-electrolyte drinks better-sustained physical performance during prolonged work in hot weather. This study provided the following evidence:

- adequate carbohydrate intake is necessary to sustain work performance during prolonged military relevant training ;
- carbohydrate–electrolyte drinks provide an accessible source of energy (and carbohydrate), which can be advantageous when limited food is available or inadequate food consumption is likely.
- mean time to exhaustion was increased with carbohydrate feedings;
- carbohydrate feedings during both rest and exercise resulted in longer time to exhaustion compared to feeding only during the rest break.

Thus, collectively, these observations demonstrate that both energy intake and the timing of intake are important variables for optimising soldier performance during many hours of prolonged hard work and that liquid carbohydrate feedings are an acceptable method of delivering energy and carbohydrate to the soldier. Carbohydrate feeding studies suggest that carbohydrate drinks are a method to increase energy intake of soldiers during field operations and increase the

likelihood of sustained performance when limited food is available or inadequate food intake is likely.

Research has shown that the body is most receptive to the restitution of its glycogen stores during the first ten hours after depletion (Costill, 1978). Burke (2001) suggests that endurance athletes should be provided with a daily CHO intake of 7-10 g/kg body mass to ensure restoration of muscle glycogen stores between training sessions. As manual tasks are similar to athletic activities and are often "endurance-type" activities, mineworkers should be encouraged to take in similar amounts of CHO. The practice of feeding a high carbohydrate meal at the end of the day's shift should be standard.

2.2.4 Protein

Protein is important for the growing child, for the young novice and for any malnourished recruit entering the industry. Wyndham, C.H. et al. (1962) showed that the recruits to the mining industry gained 3 to 4 kg in body mass during the first two months of their employment. Most of this gain in body mass was attributed to muscle growth and development as these recruits showed hardly any fat.

Protein requirements are slightly increased in highly active people. Protein recommendations for endurance athletes are 1.2 to 1.4 g/kg body weight per day, whereas those for resistance and strength-trained athletes may be as high as 1.6 to 1.7 g/kg body weight per day (Lemon, 1998 and Tarnopolsky, et al., 1992). These recommended protein intakes can be met generally through diet alone, without the use of protein or amino acid supplements, if energy intake is adequate to maintain body weight.

2.2.5 Fat

Fat supplementation was considered a potential energy source due to fat's high energy content. To test whether this diet manipulation was an advantage for the soldier, Hoyt, R.W. (1991) conducted a study. Eight test subjects consumed both a control diet (energy INTAKE=9630 kJ/d, 285 g carbohydrate, 70 g protein, 105 g fat) and an experimental diet composed of the control diet plus the addition of 102 g of fat (energy INTAKE=13470 kJ/d). The groups were studied alternately for 5

days at a time over a 4-week period. Performance was measured as time to fatigue during an incremental treadmill test while wearing a 15 kg pack. There appeared to be no physical performance advantage to supplementing the ration with fat. The results from this study as well as those from non-military sources have focused ration developers away from trying to design a ration based on energy to a ration that provides adequate carbohydrate and protein to sustain metabolism. High and efficient performance is not possible when only fat is utilised for energy. Benade *et al*.. (1973) showed that the workers heart rates and body temperatures tend to increase in parallel with its increased fat utilisation. This can be prohibited by methods, which would induce the body to revert to carbohydrate metabolism i.e. by a mid-shift supplementation of carbohydrates.

Fat intake should not be restricted, because there is no performance benefit in consuming a diet with less than 15% of energy from fat, compared with 20% and 25% of energy from fat.

At lower exercise/work intensities (less than 60% VO2 max), individuals can exercise for several hours, as fat is the dominant fuel source. A consequence of endurance training is an increased ability to use fats as an energy source, thereby saving one's carbohydrate stores for later use (Brooks, et al., 1994).

2.2.6 Micronutrients

Micronutrients play an important role in energy production, haemoglobin synthesis, maintenance of bone health, adequate immune function, and the protection of body tissues from oxidative damage. They are also required to help build and repair muscle tissue following exercise. Mineworkers should strive to consume diets that provide at least the RDAs or Dietary Reference Intakes (DRIs) for all micronutrients from food. It is assumed that the current RDAs and Dietary Reference Intakes (DRIs) are appropriate for mineworkers (Nutrition and Your Health, 1989; Institute of Medicine, 1997; Institute of Medicine, 1998). No vitamin and mineral supplements should be required if a mineworker is consuming adequate energy from a variety of foods to maintain body weight. If a mineworker is dieting, eliminating foods or food groups, is sick or recovering form injury, or has a specific micronutrient deficiency; a multivitamin/mineral supplement may be appropriate. No single nutrient supplement should be used without a specific medical or nutritional reason.

Exercise/work may increase or alter the need for vitamins and minerals in a number of ways:

- Exercise/work stresses many of the metabolic pathways in which these micronutrients are required, thus exercise training may result in muscle biochemical adaptations that increase micronutrient needs
- Exercise/work may also increase the turnover of these micronutrients needs, thus increasing loss of micronutrients from the body.

The functions of vitamins and minerals related to exercise:

- The B-complex-vitamins Thiamine, riboflavin, vitamin B-6, niacin, pantothenic acid, and biotin are involved in energy production during exercise (Manore et al., 2000; Clarkson, 1998; Lewis, et al., 1997; Manore, 2000; Peifer, et al., 1997 and Sampson, et al., 1997).
    - Folate and vitamin B-12 are required for the production of red cells, protein synthesis, and in tissue repair and maintenance (McMartin, 1997).
- Antioxidant nutrients i.e. vitamin A, E, and C, beta carotene, and selenium – play an important role in protecting the cell membranes from oxidative damage. It has been hypothesised that chronic exercise produces a constant “oxidative stress” on the muscles and other cells (Clarkson, 1995 and Ji, 1995).
- Calcium is important for the building and repair of bone tissue and maintenance of blood calcium levels. Inadequate dietary calcium increases the risk of low bone mineral density if energy intakes are low, dairy products are eliminated from the diet (Dueck, et al., 1996a: pp24-40 and Dueck, et al., 1996b: pp165-193).
- Vitamin D is also required for adequate calcium absorption, regulation of serum calcium levels and promotion of bone health
- Iron plays an important role in exercise, as it is required for the formation of haemoglobin and myoglobin, which binds oxygen in the body, and for enzymes involved in energy production.
- Zinc also plays a role in growth, building and repair of muscle tissue and energy production. However, the impact of low zinc intake on zinc status is difficult to measure because clear assessment criteria have not been established and plasma zinc concentrations may not reflect changes in whole-body zinc status (Loosli, 1993).

The effects of multi-vitamin–mineral supplementation and select micronutrients have been studied to determine whether supplementation may enhance training and performance. After several high potency multi-vitamin and mineral formulations began to be marketed with the premise that more is better, concern arose that indiscriminate use might lead to nutritional imbalances. Supplementation had not been shown to be beneficial in healthy adults eating a well-balanced diet. Singh, et al. (1999) examined the impact of 90 days of multi-vitamin–mineral supplementation in a double blind, placebo-controlled design. Twenty-two healthy, physically active men were randomly assigned to a supplement group or placebo group. Performance measures included maximal oxygen consumption, endurance time, and isokinetic tests. Supplementation did not affect maximal oxygen consumption or treadmill time to fatigue (20.0±0.5 versus 20.0±0.4 min pre- and post-supplementation, respectively). Physiological responses to a 90 minute endurance run were also not affected by supplementation. This data confirmed that 3 months of vitamin–mineral supplementation had no obvious beneficial effect on physical performance of well nourished, physically active men.

2.2.7 Other

2.2.7.1 Creatine

The dietary supplement creatine monohydrate has been very popular with athletes and individuals attempting to increase their strength and muscle mass for cosmetic reasons. Interest in its potential to enhance strength and performance began after it was reported that creatine monohydrate supplementation increased muscle total creatine concentrations and increased time to fatigue during repeated bouts of very high intensity exercise (Greenhaff, et al., 1993 and Harris, et al., 1992). Available data (Warber, et al., 2002 and Bennette, et al., 2001) suggests that while creatine may have some ergogenic properties for enhancing performance on tasks requiring high muscular power, creatine has not been shown to improve performance on occupationally relevant tasks.

2.2.7.1 Choline supplementation

Choline is a naturally occurring nutrient that is incorporated into the structure of cell membranes, plasma lipoproteins, and pulmonary surfactants. Additionally, it is a precursor for the biosynthesis of the acetylcholine, a neurotransmitter involved with memory and muscle contraction. Warber, et al. (1997) examined whether

consuming choline supplements during prolonged work sustained plasma choline better compared to placebo and whether choline supplementation improved physical performance. Choline supplementation during prolonged militarily relevant work appears to have little effect on sustaining or enhancing physical performance capabilities.

2.3 Mine nutrition and studies

The physical demands of both mechanised and conventional underground gold mining operations in South Africa are reported to be of a moderate to heavy intensity (van Rensburg, et al., 1991). In addition to high physical demands of the job, consideration must also be given to the environmental conditions common in South Africa. The high ambient temperatures are exacerbated underground, and are such that heat stress is a major contributor to decreased physical capacity. It is well established that any exercise in a hot environment requires specialised dietary considerations (Burke, 2001 and Jentjens, et al., 2002) and that improving performance under these conditions requires proper nutritional supplementation (Costill, et al., 1988).

The three basic macronutrients (Table 2.3), carbohydrates, fats and proteins, are found in the normal hostel diet. Most natural foods contain at least some of each of the three nutrients. Previous surveys have established that the amount of carbohydrates, fat and proteins supplied in the normal hostel diet are more than adequate, if not excessive (Fleming, et al., 1966b and Strydom, 1979)

The most important nutrient for the mineworkers working moderately hard is carbohydrates and fats because these two nutrients are used exclusively for energy. Feeding excessive amounts of protein is expensive and not necessary, but it is appreciated that mineworkers eat, not according to their needs, but rather according to their likes.

Table 2.3: Major sources of nutrients

Nutrient	Major Sources
Carbohydrates	Sugar, jam, mealie products, wheat products, and potatoes.
Fat	Butter/margarine and vegetable oils
Protein	Meat, fish, poultry, cheese, eggs, beans, peas, lentils, peanuts

2.3.1 A survey on the quantities of foodstuffs issued to mineworkers

A comparison was presented of the quantities of various foodstuffs prescribed in the government minimum ration, and with those issued in a compound where men were issued food “on demand”, resulting therefore in a minimum of waste (Fleming, et al., 1966b).

Twenty-five compounds were randomly selected from 7 groups in the gold-mining industry. All foodstuffs at each compound kitchen issued were weighed over two separate periods of one week each during a period of fifty-one weeks in a year.

It was concluded that the industry would not be able to feed the quantities of maize, bread and beans specified in the Government minimum ratio without increasing the quantities of compound waste (see Table 2.3.1)

Table 2.3.1: Comparison of food quantities issued

	Government minimum (ozs/man/day)	Industry “mean” (ozs/man/day)	“On demand” compound (ozs/man/day)
Mealie meal	-	18	12.3
Total maize	24	20	12.9
Bread	6	5.5	4.5
Beans	3 – 4	2	1.2
Meat and fish	8.6	8.9	8.9

The quantities of foodstuff in the “on demand” system of the compound feeding have been shown in Research report No.55/65 (Fleming, 1965) to be adequate in terms of calories, total protein and essential amino acids, judged in relation to international standards.

2.3.2 Estimated metabolic rates associated with underground mining tasks.

Van Rensburg, et al. (1991) provided estimates of metabolic rates for underground mining tasks (see Table 2.3.2).

The main findings and conclusions were:

- Metabolic rates associated with conventional and mechanised underground mining occupations are, on average, of a moderately high intensity (> 130 to 180 W/m²). Hard work (metabolic rate 181 to 240 W/m²) is performed, however, and is primarily associated with occupations directly involved with production. Very hard work (metabolic rate > 240 W/m²) is generally of short duration and appears to be the exception rather than the rule.
- A high degree of self-pacing appears to occur during a normal shift for both conventional and mechanised mining tasks, i.e. workers allow themselves periods were only light work is performed or even periods of complete rest.

Table 2.3.2: Mean metabolic rates, shift duration and energy expenditure

Work category	Mean metabolic rate (W/m²) over full working shift	Shift duration (min)	Energy expenditure (kJ)
Stoper	160	511	9722
Developing team	163.3	545	9238
Stope team	163.9	551	9218
Miner assistant	164	538	9001
Cleaning team (night shift)	164.1	510	8848
Loader driver	170.1	545	9568
Winch driver	170.3	556	9718
Driller	176.1	567	10618
Drill assistant	178	575	10694

2.3.3 Pre, Mid and Post shift feeding

Exercise performance is optimal when athletes maintain fluid balance during exercise; conversely, exercise performance is impaired with progressive dehydration (Barr, et al., 1991; Below, et al., 1995; McConnell, et al., 1997; Montain, et al., 1992 and Walsh, et al., 1994). Moreover, dehydration increases the risk of potentially life-threatening heat injury such as heat stroke (Noakes, 1993).
Local research in the mining industry has been focused predominantly on occupational injuries. For example, it was found on various Witwatersrand mines that the introduction of mid-shift feeding improved the workers' performance, reduced accidents, and decreased absenteeism caused by illness (Smith, et al., 1989).

As early as 1959 the Applied Physiology Laboratory of the Chamber of Mines started with surveys and assessments of food issued to black mine workers. Body stores of carbohydrates are near capacity after the night's rest and the previous

day's large meal. Mineworkers go underground early in the morning at 3 to 5 am, and may not be hungry at the time. Supplying a mild breakfast would certainly have benefits, but eating a large morning meal could negatively affect work performance, especially if such a meal consists of large amounts of protein and fat since proteins not only inhibits gastric emptying but also increases the digestive period (Strydom, 1979). The pre-shift meal should be relatively low in fat and fibre to facilitate gastric emptying and minimise gastrointestinal distress, be relatively high in carbohydrates to maximise maintenance of blood glucose, be moderate in protein, and be composed of foods familiar and well tolerated by the mineworker.

The effects of a light carbohydrate breakfast would be to cover the two to three hour period of waiting or walking prior to the start of the shift. It would ensure that the body's carbohydrate stores are still at maximum capacity when work eventually starts and prevents the decline in carbohydrate usage (or the increase in fat utilisation) during a shift lasting 6-8 hours.

Mineworkers may start the shift dehydrated from the effects of alcohol[2] taken the night before. Providing the mineworker with 400-600 ml of fluid at breakfast would at least ensure that the mineworker is not too dehydrated. During exercise 150 – 350ml of fluid should be consumed every 15-20 minutes depending on tolerance.

A decline in carbohydrate usage can also be achieved by one or two mid-shift feeds. Under the mining conditions this should consists of a carbohydrate snack/drink containing no fat or proteins. The benefits to be gained from a midshift snack would surpass any possible loss in production, as the men will be more productive after the break (Strydom, 1979). Consuming 0.7g carbohydrates/kg body weight per hour (approximately 30 to 60 g per hour) has been shown unequivocally to extend endurance performance (Coggan, et al., 1991).

These nutritional guidelines are especially important for endurance events lasting more than 1 hour, when the mineworker has not consumed adequate food or fluid before the shift, or if the mineworker is working in an extreme environment (heat, cold, or altitude).

Physiologically speaking, the advantages of a fluid meal for both pre- and midshift feeding would far outweigh those containing solids. Any form of solid sugar such as energy bars, highly concentrated syrups or combination foods should be avoided

[2] Alcohol is a diuretic resulting in the individual passing more water than consumed

during the mid-shift period. These foods are hypertonic and upset the body's osmotic balance leading to the withdrawal of body fluids, from the body to the gut, in the attempt to dilute the substance. This would lead to dehydration, which would have a deleterious influence on heat regulation and thus on work performance, heart rate and body temperature (Buskirk, 1958). Studies have shown that a mid-shift feed of a sugar solution is readily absorbed in the gut of a working man during an 8-hour shift.

After exercise, the mineworker should drink adequate fluids to replace sweat losses during the shift. The mineworker needs to drink 450 – 675ml of fluid for every pound (0.5kg) of body weight lost during exercise. The dietary goal is to provide adequate energy and carbohydrates to replace muscle glycogen and to ensure rapid recovery. If an athlete is glycogen-depleted after exercise, a carbohydrate intake of 1.5 g/kg body weight during the first 30 minutes and again every 2 hours for 4 to 6 hours will be adequate to replace glycogen stores. Protein consumed after the shift will provide the amino acids for the building and repair of muscle tissue. Therefore, mineworkers should consume a mixed meal providing carbohydrates, protein, and fat soon after a shift.

2.3.4 Hydration and Physiological response of men working in heat

Athletes dissipate the metabolic heat produced during physical activity by radiation, conduction, convection and vaporisation of water. In hot, dry environments, evaporation accounts for more than 80% of metabolic heat loss. Sweat rates will vary depending on variables such as body size, exercise intensity, ambient temperature, humidity, and acclimation, but can exceed 1.8 kg (approximately 1,800 ml) per hour (American College of Sports Medicine, 1996). In addition to water, sweat also contains substantial amounts of potassium, small amounts of minerals such as iron and calcium. The risks of men reaching body temperatures of heat stroke level are increased by five-fold in the men who are deprived of water compared with those men drinking water *at libitum*[3].

Euhydration (and the associated maintenance of physiological function and performance) can be accomplished during exercise only if the rate of fluid ingestion and absorption equals the rate of fluid loss through sweating (and urination). Fluid balance is not always possible during work in a hot environment because maximal

sweat rates exceed maximal gastric emptying rates, which in turn limit fluid absorption. In most cases, however, rates of fluid ingestion by mineworkers during the shift fall short of amounts that could be emptied from the stomach and absorbed by the gut (American College of Sports Medicine, 1996).

The fact that men do not drink sufficient water to replace the amounts of fluids lost in sweat is well known (Grande, et al., 1959; Pitts, et al., 1944; Wyndham, 1969 and Sohar, et al.., 1962). Strydom, et al.. (1975) showed that the physiological reactions of men on full water replacement were better than when they drank water *ad libitum*[3]. When a man drinks according to his thirst reflex (*ad libitum*[3]), his performance deteriorates in parallel with a slowly increasing extent of dehydration. An understanding of the underlying physiology is important to establish an effective replacement regimen.

The following facts are important (Kielblock, 2001):

- A person's thirst is alleviated when drinking water, because of stomach fullness and not because the fluid deficit is recovered.
- Once dehydration has set in, the subsequent rate of water absorption from the gut will be reduced as a result of compensatory splanchnic vasoconstriction.
- Sweat is hypotonic with electrolyte content varying between 0.2% to 0.3%. The most important constituent is sodium chloride (salt), which accounts for about 80% of the tonicity of sweat.

On a balanced diet, or in the short-term (hours), the threat to continued well being does not reside in salt depletion but in dehydration. Several studies have shown the disadvantages of salt (sodium chloride) supplementation during heat exposure (Strydom, et al., 1968:23 and Jooste, et al., 1980:3). Fluid loss, rather than salt loss, is the major cause for heat cramps and heat exhaustion, while salt loss has never been implicated in the more serious conditions of heat stroke (Strydom, 1982).

Optimum hydration is best achieved by drinking relatively small amounts of water at relatively short intervals, e.g., about 250-300ml every 20-30 minutes. Basic physiological requirements are effectively met by ordinary tap water. Availability and palatability of water is important. An optimum temperature, in terms of palatability, is 15°C. Both alcohol and caffeine-containing beverages significantly

[3] At one's pleasure; as one wishes

increase diuresis and therefore counteract full rehydration (Kielblock, 2001). Worker education regarding use of both beverages is, therefore, essential.

The most significant breakthrough in heat acclimatisation occurred with the supplementation of ascorbic acid (vitamin C) (Kielblock, 2001 and Strydom, et al., 1976:41). Vitamin C decreased the number of heat intolerants, i.e., men who do not respond to the acclimatisation routine (Strydom, 1982). Laboratory tests also showed that men who are acclimatised by the vitamin-assisted 4- or 5- day procedure are as well acclimatised as those exposed for 8 days. Moreover, they do not lose this achieved state of adaptation while working underground, even though no further vitamin C supplementation is given (Strydom, 1982).

2.3 South African food based dietary guidelines

A number of countries and regions have developed food-based dietary guidelines (FBDGs) as the growing perception is that nutrient-based guidelines are not effective in promoting appropriate diets and healthy lifestyles (Vorster, et al., 2001).

Many countries had dietary guidelines expressed in scientific terms, as Recommended Dietary Allowances (RDAs), Reference Nutrient Intakes (RNIs) and Dietary Reference Values (DRVs). There are two problems with using dietary guidelines: individuals do not know their true nutrient requirements and the information about the actual nutrient content of the foods they eat is incomplete (Vorster, et al., 2001).

The guidelines can be used as a consistent communication tool because they represent expert agreement on how diet-related public health problems should be addressed by dietary recommendations to consumers. The following guidelines are based on the existing consumption of locally available foods in South Africa and aim to address identified nutrition-related public health problems. The FBDGs consist of 10 short clear and simple messages, which have been tested for comprehension, appropriateness and applicability in consumer groups of different ethnic backgrounds in both rural and urban areas (Vorster, et al., 2001).

The guidelines are:

- Enjoy a variety of food
- Be active
- Make starchy foods the basis of most meals
- Eat plenty of fruit and vegetables
- Eat dry beans, peas, lentils and soya often
- Meat, chicken, fish, milk and eggs can be eaten every day
- Eat fats sparingly
- Eat foods and drinks containing sugar sparingly and not between meals
- Drink lots of clean, safe water
- If you drink alcohol, drink sensibly.

Mineworkers work hard and starchy foods are the basis of most of their meals. Hostel dwellers are provided with meat, chicken, or fish every day. Mineworkers should be encouraged to eat plenty of fruit and vegetables. Mineworkers should also be encouraged to consume dry beans, peas, lentils and soya frequently. Alcohol should only be consumed over weekends and not the day/night before work. Clean, safe water must be made available to all mineworkers especially during the shift.

2.5 Nutrition and occupational health and safety

The importance of nutrition in relation to absenteeism, physical efficiency, proneness to injuries etc. is well recognised (Brooks, et al., 1994), (Below, et al., 1995) and (Goedecke, et al., 1999). Information, including recent studies on nutrition and occupational health is scarce and limited in content. The researchers were unable to find recent comprehensive studies, despite contacting organisations both locally (MRC, NCOH) and internationally (FAO/WHO) and doing an extensive search using Pubmed and Science Direct Library (one of the world's largest providers of scientific, technical and medical (STM) literature. The emphasis on nutritional research is usually focused on women and children and, more recently, on HIV.

Henschel, et al. (1954) and Taylor, et al. (1954) examined the effects of a 4-day fast combined with a high total daily energy expenditure on the capacity to perform moderate and extreme physical work. The following was found:

- Heart rate during aerobic work was higher
- Following work, heart rate returned to pre-exercise resting values slowly.
- Absolute maximal oxygen consumption (l/min) declined 8% after 4-day of fasting, but the decline was no longer apparent when VO_2 max was normalised for changes in body weight by expressing oxygen consumption on a per kilogram body mass basis.
- Subjective symptoms were also noted, with the subjects complaining of fatigue, muscle soreness and weakness during and for several days of recovery after the fasting period. Crowdy, et al. (1971) reported that soldiers underfed by approximately 50% of their energy expenditure had changes in the social and physical behaviour on non-tested tasks over the final 3 days of a 14-d field exercise.

Therefore, performance of tasks where the energy cost is determined by body mass, would not be expected to be affected. Tests derived from more militarily relevant types of tasks and activities have generally been unable to detect differences in performance, even when underfeeding was observed to reduce VO_2 max (Jacobs, et al, 1989), (Consolazio, et al., 1979 and Guezennec, et al., 1994). Nevertheless, the reduction in VO_2 max appears to be a real consequence of short-term energy restriction and may have implications on performance, especially for non-weight bearing tasks (e.g. lift and carry tasks) that require a high percentage of aerobic capacity (Montain, 2002).

Before concluding that short-term underfeeding has no effects on occupationally relevant performance, there are a number of confounding factors that need to be considered:

- Many of these studies were composed of relatively small sample sizes
- Within-group variability was quite large.
- Performance scores improved over time, indicative that the subjects were either becoming more fit or were learning the task with repeated testing.
- Job performance in the workplace is composed of continuous work where many tasks are performed sequentially and work productivity is the sum performance on all these tasks. Therefore, while performance on an individual test may suggest no impact of diet, this does not mean that daily work productivity would be unaffected.
- If underfeeding negatively impacted mood and behaviour only, it may be that the specific tests used were insensitive to detect reductions in physical

performance, or the test paradigm was too brief and isolated to measure possible decrements in performance.

Local research related to the mining industry has been focused predominantly on occupational injuries. For example, it was found on various Witwatersrand mines that the introduction of mid-shift feeding improved the workers' performance, reduced accidents, and decreased absenteeism caused by illness (Smith, 1989).

An international study on the relationship between nutrition and health and safety conducted in 1985 showed that health conditions in the Huainan Coal Mine had improved greatly since 1950. In particular, the work and living environments, the underground dust concentration, the water supply and waste disposal systems, and the nutritional value of miners' food were improved. With these improvements, the rates of occupational, infectious, and parasitic disease and nutritional deficiency diseases decreased considerably among the miners (Yang, et al., 1985). This study demonstrated a possible correlation between an improvement in nutrition and a reduction in occupational diseases. Unfortunately, however, in this study nutrition formed part of a general improvement in working conditions and the exact role it played is unclear.

Philip, et al.. (2003) aimed to examine the effects of different energy intakes on a range of responses that are relevant to the safety of hill walkers. In a balanced design, 16 men completed a strenuous self-paced mountain hill walk over 21 km, under either a low-energy (2570 kJ) intake (LEI) or high-energy (12640 kJ) intake (HEI). The LEI group showed significantly slower one- and two-finger reaction times, had an impaired ability to balance, and were compromised in their ability to maintain body temperature, when compared with the HEI group. A relevant observation was that four of the subjects on the LEI sustained minor injuries during the walk. There is some evidence that low muscle glycogen levels (as seen in the LEI group) are associated with increased injury risk in alpine skiing (Ericksson, et al., 1977). This is because glycogen depletion of the fast twitch fibres will limit the ability to develop a high muscle tension in a short period of time (needed to correct false turns or inadequate timing) (Coyle, 1992). Physical inability to correct movements will in time lead to increased injury risk (Coyle, 1992).

Many of the workers in developing countries suffer from poor nutrition, endemic diseases, and other debilitating conditions. For this reason, Ong, et al. (1993) suggest that it is possible that currently recommended occupational exposure limits

may allow injury to workers in the developing nations. They suggest that poor nutrition may predispose workers to occupational diseases at occupational exposure limits that are considered normal for a well-fed population.

2.6 Nutrition and illnesses

The increasing emergence of non-communicable diseases (i.e. hypertension and diabetes) compounded by the HIV/AIDS pandemic, presents a complex picture for health workers and policy makers. Increasing emphasis needs to be placed on healthy lifestyles. Shifts in dietary intake, to a less prudent one, are occurring with increasing momentum, particularly among blacks, who constitute three-quarters of the population.

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2.6.1 HIV and TB

"Worldwide, the number of individuals who are co-infected with HIV and TB is increasing greatly. The "triple trouble" of HIV and TB and malnutrition may put those infected at greater risk than those with any of the three conditions alone. Further investigation is needed to evaluate the prophylactic and therapeutic potential of nutritional interventions for co-infection with HIV and TB" (Van Lettow, et al., 2003). TB and HIV infection are known to be separately associated with malnutrition (Scalcini, et al., 1991; Suttmann, et al., 1995; Harries, et al., 1988; Kennedy, et al., 1996; Klausner, et al., 1996). Malnutrition itself is a cause of immunosupression (Harries, et al., 1988). The malnutrition that is symptomatic of these illnesses may be related to decreased food intake from loss of appetite or an inability to purchase or grow food because of disability related to TB and HIV-related illness. In addition, painful swallowing, inability to absorb the food in the gut, and increased energy expenditure might play a role in HIV positive patients (Murray, 1984 and Macallan, 1992).

Niyongabo, et al., 1999, demonstrated that clinical and, when possible, biochemical follow-up of the nutritional status of African TB patients might be beneficial. Among the HIV positive TB patients investigated, hypoalbuminemia was striking. It has been clearly demonstrated in industrialised countries that malnutrition has adverse prognostic significance in HIV positive patients (Niyongabo, et al., 1999). Several studies have shown that weight loss, decreased BMI, decreased body cell mass

(BCM), and hypoalbuminemia predict a shorter survival in AIDS patients (Suttmann, et al., 1995 and Kotler, et al., 1989).

2.6.2 Obesity, Diabetes and Hypertension

Persons with a body mass index (BMI) (weight (kg)/height (m^2)) of 25 to 29.9 are considered to be overweight; when, the index is 30 or over, obesity is regarded as present.

"The hungry and the overweight share high levels of sickness and disability, shortened life expectancies, and lower levels of productivity-each of which is a drag on a country's development," said Gary Gardner, co-author with Brian Halweil of Underfed and Overfed: The Global Epidemic of Malnutrition (Gardner, 2000). An improper diet may provide inadequate fuel for physical work, may predispose to fatigue, and may increase the risk of injury. In South Africa, macronutrient dietary intake profiles among adults range from prudent among blacks, to Western in other groups. However, data have shown that among urban blacks, fat intakes have increased by 63% while carbohydrate intakes have fallen by 14% in the past 50 years. Shifts towards the Western diet are apparent among rural African dwellers as well (Bourne, et al.., 2000).

In African adult populations, little more than a generation ago, rises in weight-with-age were slight, as was also the case with blood pressure. (Walker, 1964) However, within recent years, in Southern African populations the situation has changed considerably. BMI, and the prevalence of overweight and obesity in women and men in a number of African countries are shown in Table 2.6.2.1 and Table 2.6.2.2 (Martorell, et al., 2000; van der Sande, et al., 1997; de Villiers, et al., 1988; Vorster, et al., 1994; Walker, et al., 2000; Steyn, et al., 1998 and Seedat, et al., 1992). For comparison, data are included for African-Americans (Jensen, 2000).

Table 2.6.2.1. Body mass index and percentages of overweight and obese African women

Country	BMI (mean)	Overweight (%)	Obese (%)
Namibia	22.5	23.8	7.1
Zimbabwe	23.1	27.4	5.7
Tanzania	21.7	9.3	1.9
Gambia	21.3	8.1	
South Africa			
Rural Zulu		10	31.6
Rural Venda	25.4		19.9
Johannesburg squatters	29.8		33.3
Cape Town	27.8	36.4	34.4
Durban	26.6	42.4	22.6
African American		39.3	36.7

Table 2.6.2.2. Body mass index and percentages of overweight and obese African men

Country	BMI (mean)	Overweight (%)	Obese (%)
Gambia	20.1		
South Africa			
Rural Venda	33.5		29
Johannesburg squatters	21.1		6.6
Cape Town	33.4	23	7.9
Durban	33.4	16.8	3.7
African American		36	20.7

Diet and the excessive intake of fats in particular, has long been recognised as a risk factor for the development of heart and other degenerative diseases in Western countries (Masironi, 1970 and Ulbricht, et al., 1991). One of the hypotheses supported by rural/urban comparisons of African populations has been that with urban exposure the traditional diet is abandoned for a Western diet, typified by decreases in carbohydrates and fibre and increases in fat (Bourne, et al., 2000). The traditional diet is associated with a low prevalence of degenerative diseases (Burkitt, 1982 and Segal, et al., 1986). However the available data serves to illustrate trends (Bourne, et al., 2000), namely;

- there is little variation in the proportion of protein intake over time, and between rural and urban areas;

- fat intakes show an overall upward trend over time in both rural and urban areas; and
- conversely, the proportion of energy derived from carbohydrates decreases in both urban and rural areas.

The prevalence of hypertension and dyslipedaemia reported from five cross-sectional studies (Steyn, et al., 1992) are presented in table 2.6.2.3. These studies utilised standardised methods and included the coloured community in the Cape Peninsula (Steyn, et al., 1985), the Indian community in Durban (Seedat, et al., 1990), the black community in the Cape Peninsula (Steyn, et al., 1991), the black community in QwaQwa (Mollentze, et al., 1995) and the white community of the south-western Cape (Rossouw, et al., 1983). Comparisons were made after age-standardisation of the prevalence in each study against a world population standard.

Table 2.6.2.3 Prevalence (%) of hypertension in men and women (15-64 years) in South Africa

	Hypertension in males (BP >160/90mmHg)	Hypertension in females (BP >160/90mmHg)
Urban coloureds	23	25
Urban blacks	11	15
Rural blacks	18	23
Urban Indians	17	17
Rural whites 1979	19	20
Rural whites 1991	19	12

Prevalence of diabetes varies between the different population groups in South Africa and may be due to differences in diet and lifestyle. In the past, when blacks followed a traditional lifestyle, diabetes was virtually absent (Steyn, et al., 1992). Most recent community-based studies using the 1985 World Health Organisation (WHO) criteria for diabetes indicate that the prevalence is considerably higher in African subjects than it was approximately 25 years ago, ranging from 5% in Gauteng (Omar, et al., 1993) to 8% in Cape Town (Levitt, et al., 1993). However, the true extent of this change may be confounded by differences in study methods.

All the studies are on the general population, which may include the mineworkers. There is no data on nutrition and its effect on HIV, TB, hypertension or diabetes for the mining industry.

2.7 Food fortification

In April 2003, under the Foodstuffs, Cosmetics and Disinfectants Act (No 54 of 1972), the final regulations for the fortification of maize meal and wheat flour in SA were published. In 1999, the Department of Health went around South Africa speaking to people from different socio-economic areas to determine the types of meals consumed, how often and how much money they spent on food (Nel JH and Steyn NP, 2003).

They found that most children do not get enough food and micronutrients in their daily meals resulting in children being underweight and stunted. Most families have very little money to spend on food and maize meal, white sugar, tea, whole milk and bread were the most popular bought and eaten foods. Therefore, as from October 2003 white and brown bread flour and maize meal will be fortified with the following vitamins and minerals:

- Vitamin A
- Thiamine (Vitamin B1)
- Riboflavin (Vitamin B2)
- Niacin
- Folic acid
- Pyridoxine (Vitamin B6)
- Iron
- Zinc

3. Research method

3.1 Workshop

A workshop seminar with experts and stakeholders to discuss the methods to be used in the study was held, on 16 of August 2003 at Goldfields Academy. Presentations were given by Prof Ross from SIMPROSS on B*ackground and Motivation for Study* and by Dr AJS Benadé, Director of the Nutritional Intervention Research Unit (NIRU) of the Medical Research Council (MRC) on N*utritional Status, Work Performance and Occupational Health*. Mrs E Bredenhann, dietician consultant for a platinum mine, presented a paper on *Mine Diets: current situation*. Dr B Dias, principal investigator of the study, from CSIR Miningtek, discussed the questionnaires developed for the collection of demographic data and for the knowledge attitude and practices (KAP) study. Dr P Wolmarans, research dietician from NIRU, MRC, explained the advantages and disadvantages of the 24-hour dietary recall method selected for use in the collection of quantitative dietary intake data on the study population. It was also explained that this method was chosen because a validated food frequency questionnaire was not available for the collection of data on the study population. Time constraints prevented the development of such a questionnaire before the study started. In addition, the researcher questioned the suitability of using a food frequency questionnaire in this study population.

Hostel managers from the mining industry, members of MOHAC, NUM and the DME and occupational medical practitioners were invited and attended the nutrition workshop.

The outcomes of the workshop were as follows:

- Concerns were raised about the objective of the study i.e. health and safety not being addressed. This resulted in the formulation and addition of 3 extra questions, i.e. (a) injuries sustained by the mineworker, (b) the need for compensation as a result of injury, and (c) history of TB. Questions on chronic medical conditions like diabetes and hypertension were also formulated and included in the questionnaire.
- Concerns about the use of the 24-hour recall method were raised by some of the attendees, but no better alternative could be suggested. It was,

therefore, decided that this method would be the best for collecting quantitative dietary intake data in this study population.

- It was decided that mineworkers involved in production would be selected on a convenience basis and would not be randomly selected for the interview.
- A decision was taken that the KAP study for hostel managers (appendix 8.4) would evaluate the knowledge, attitudes and practices of hostel managers.
- A telephone survey would be used to evaluate the knowledge, attitudes and practices of the mine manager's and employers.

3.2 Study design

This was a descriptive cross-sectional study. It provides a situational analysis of mines that represent most of the mining commodities found in the South African mining industry, and focuses on relevant aspects of the main catering arrangements that are currently being adopted at each mine and the dietary intake of a conveniently selected sample of black mineworkers.

3.2.1 Study population

The study population consisted of black male mineworkers between the ages of 19 and 64 selected from 10 mines, two coal mines, one platinum mine, two gold mines, two quarries (opencast), a diamond mine, an iron mine (open cast) and a manganese mine.

To investigate the main catering arrangements at the mines seven-hostel managers were interviewed.

3.2.1.1 Sample selection and size

A study group of 50 mineworkers[4] were selected from each of the 10 mines for the dietary intake questionnaire and KAP study. When the total workforce at the mine was less than 50, the total population at the mine was studied. The total sample size studied was 498 mineworkers. Contact person at each mine made every

effort to ensure that minerworkers who lived in hostels (and were catered for by the mines) and those who lived outside and were responsible for their own meals were included in the sample. The participants were selected on a "convenience" basis, which depended on logistical considerations determined in discussions with mine officials and union representatives at each site.

3.2.2 Measurements

In situ *inspection*

Hostel kitchens and the menus at each hostel kitchen were assessed (Appendix 7.4). A member of the study team to collect information on the catering arrangements of the hostel kitchen conducted a structured interview with the hostel manager.

A convenience sample of 10 plates of food / food items were selected and weighed to determine the average portion of food usually served to an individual mineworker.

24-hour-recall method questionnaire

Four fieldworkers, one medical doctor, one nursing sister, one nutritionist and one general worker from a mine were trained by a specialist scientist (dietician) from NIRU, MRC, in the collection of 24-hour dietary recall data. Fieldworkers received 2½ days of practical training on how to record the time the food was eaten and how to ask about the type of food eaten and the preparation methods, e.g. whether fried and, if so, in what. Emphasis was placed on the correct quantification of the food eaten. Real food, plastic and sponge food models, and household and metric measures, e.g. tablespoons, cups, etc., were used to quantify food consumed. Fieldworkers were also shown how to use a ruler for quantification, e.g. to determine the dimensions of a piece of meat or the dimensions of an apple. Each fieldworker received a manual explaining in detail how to collect the 24-hour recall data. Role-playing during the training sessions was also used to familiarise the fieldworkers with the 24-hour methodology; e.g. fieldworkers role-played interview techniques and how to collect and record the data.

Dietary data were collected at the different mines by the trained fieldworkers. Initially all interviews were observed by the medical doctor and then randomly as a

[4] Fifty is the number required when the 24-hour dietary recall method is used to determine the nutrient intake of a population.

quality control measure. Mineworkers were interviewed on different days to cover the different diets and reduce the limitations.

KAP Study

A focus group was conducted with a group of mineworkers to develop the questionnaire. After the focus group discussions only minor changes were made to the original questionnaire compiled by the principle investigator

The KAP study questionnaire consisted of the following questions:

- Eating habits and;
- beliefs, perceptions and knowledge concerning food, health and hostel food.

The questionnaire (appendix 8.2) completed by the interviewers also included the following:

- demographics, i.e. age, language, job, education;
- housing, i.e. location, type of housing, rooms, kitchen facilities)
- Anthropometry. Fieldworkers trained in the collection of anthropometric data were responsible for the following measurements:
  - Weight was determined in light clothing without shoes on a TB-521 Body fat monitor and scale to the nearest 0.1kg.
  - Height was determined without shoes.
  - Body fat was determined with TB-521 Body fat monitor and scale.

Body mass index was calculated using the formula: body mass (kg)/ (weight in m)^2

3.3 Data analysis

Dietary data were coded by a dietician for the type and amount of food and drink consumed, using food codes from the South African Food Composition Database and quantities from the MRC Food Quantities Manual (Langenhoven, 1991a). As mentioned, the size of some food portions was determined by means of sponge models and the weights of these portions were then determined by weighing the real food for coding purposes. The coded data were computerised and SAS (Version 8) was used for the analyses of the dietary data.

Data from the 24-hour dietary recall method are presented as follows:

- Descriptive statistics (mean and standard deviations) for the study population and for the total population, divided into those living outside the hostels and those living in the hostels.

- Micronutrient intakes compared with dietary reference intakes (Trumbo, et al., 2001);

- Macronutrient intakes expressed as a percentage of the total energy intake; and

- The food that formed the main part of the diet of miners at each mine.

The ratio of recorded energy intake (24-hour recall data) to estimated Basal Metabolic Rate (BMR_{est}) was calculated. To calculate BMR_{est} the Schofield equation was used (Schofield, 1985).

The Wilcoxon Two-sample Test was used to test for significant differences and a level of $p<0.05$ was taken as significant.

3.4 Ethical and legal considerations

Ethics approval was obtained from the University of the Witwatersrand before the fieldwork began (the clearance certificate protocol number is M02-07-33).

Each researcher's paramount consideration was the people studied. The autonomy, dignity and privacy of all subjects were respected. The aims of the investigation were communicated to the subjects in a language that they understood.

Subjects participated in the study on the basis of informed consent, and on the understanding that they could refuse to participate or could withdraw from the study at any time. Care was taken to maintain confidentiality so that subjects were not identifiable to persons not involved in the research.

4. Results and discussion

4.1 Demographics

KEY FINDINGS (SECTION 4.1)

- A total of 497 mineworkers were interviewed. Fifty-seven percent of these were non-hostel dwellers and 43% were mineworkers who stayed in a hostel.
- At the mines with hostels, hostel dwellers were not significantly older than non-hostel dwellers (p=0.101). The mean age of hostel dwellers was 42.9 (+- 9.2) years compared to non-hostel dwellers 38 (+- 8.86) years.
- For the study group, 24% of the study participants spoke Tswana, 22% spoke Xhosa, 14% spoke Southern Sotho, 12% spoke Pedi, 8% spoke Shangaan, 7.9% spoke Zulu and 6% spoke Swazi. The remaining 6% spoke Ndebele, Venda, Afrikaans and English.
- The difference in level of education among hostel dwellers and non-hostel dwellers is significant (p=0.045).
- In the age group 26 to 35 years, 5% of the hostel dwellers have no formal education (compared to 2% of non-hostel dwellers) (p=0.002), while 49% of non-hostel dwellers have tertiary education compared to 17% of hostel dwellers.
- In mineworkers aged >55years, 67% of hostel dwellers had only been to primary school (compared to 17% of non-hostel dwellers) while 17% of non-hostel dwellers had a tertiary education. No hostel dwellers in this group had a tertiary education.

4.1.1 Mines

Ten mines representative of all commodities and different geographical regions in the South African mining industry were selected for the study. Each mine is identified in this report by the mineral that is mined (see Table 4.1.1). The mines were located in Gauteng, Northern Cape Province, Mpumalanga, North West Province and Northern Province. Seven hostel kitchens were evaluated at six of the mines. (At the platinum mine, two hostel kitchens within the same mine were evaluated.) At five of the hostel kitchens evaluated, the mine provided the kitchen staff and facilities. At the other two mines, sub-contractors provided the staff and ran the hostel kitchen (i.e. Coal Mine 1 and Iron Mine). Two of the mines did not have a hostel kitchen (i.e. the two quarries). At the remaining two mines (Diamond Mine and Coal Mine 2) once the hostel was converted into family quarters, the need for a hostel kitchen fell away.

Table 4.1.1: Number of hostel dwellers and non-hostel dwellers interviewed at the 10 mines

	Mineworkers not staying in hostels	Mineworkers staying in hostels	Total No. of Mineworkers interviewed	Total workforce
Quarry 1	**22**		**22**	**32**
Manganese Mine	**31**	**19**	**50**	**945**
Diamond Mine	**52**		**52**	**1 525**
Coal Mine 1	**25**	**25**	**50**	**1 365**
Coal Mine 2	**50**		**50**	**787**
Quarry 2	**22**		**22**	**40**
Platinum Mine	**52**	**52**	**104**	**5 254**
Gold Mine 1	**1**	**49**	**50**	**17 680**
Gold Mine 2	**15**	**34**	**49**	**6 581**
Iron Mine	**13**	**35**	**48**	**3 500**

A total of 497 mineworkers were interviewed. Fifty-seven percent of these were non-hostel dwellers and 43% were mineworkers who stayed in a hostel.

4.1.2 Ages

Table 4.1.2 indicates the mean ages of the study participants interviewed at the different mines. The mineworkers in our study group reflect an older working force compared to the earlier workforce described by Dr Schultz (1958). The mean ages ranging from 37.5 to 47 years. It appears that hostel dwellers are either the same age or older (especially at Gold Mine 2 and the Iron Mine) than the non-hostel dwellers interviewed. However, in Coal Mine 1 and Gold Mine 1, the hostel dwellers were slightly younger.

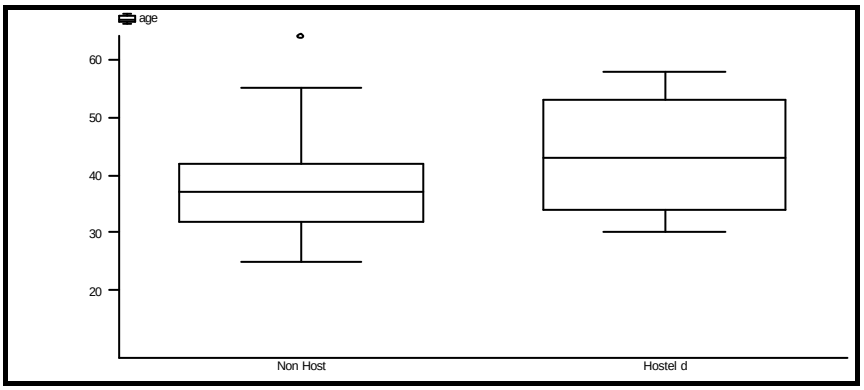


Figure 4.1.2: Range of ages of hostel dwellers and non-hostel dwellers at mines with hostels

Table 4.1.2: Mean ages of hostel and non-hostel dwellers at each mine

	Mineworkers at the mine	Study participants (Yrs)	Non-hostel dwellers (Yrs)	Hostel dwellers (Yrs)
Quarry 1	**42.0**	**42.3**	**42.0**	
Manganese Mine		**40.3**	**38.6**	**42.9**
Diamond Mine		**47.0**	**47.0**	
Coal Mine 1	**46.0**	**41.9**	**42.2**	**41.6**
Coal Mine 2	**48.0**	**44.8**	**44.8**	
Quarry 2	**42.0**	**42.4**	**42.4**	
Platinum Mine		**41.0**	**39.9**	**42.8**
Gold Mine 1	**39.1**	**39.7**	**41.0**	**39.8**
Gold Mine 2	**38.8**	**39.0**	**34.5**	**39.9**
Iron Mine		**37.5**	**35.3**	**38.3**

At the mines with hostels, hostel dwellers were not significantly older than non-hostel dwellers (p=0.101). The mean age of hostel dwellers was 42.9 (? 9.2) years compared to non-hostel dwellers 38 (? 8.86) years.

4.1.3 Languages

For the study group, 24% of the study participants spoke Tswana, 22% spoke Xhosa, 14% spoke Southern Sotho, 12% spoke Pedi, 8% spoke Shangaan, 7.9% spoke Zulu and 6% spoke Swazi. The remaining 6% spoke Ndebele, Venda, Afrikaans and English.

4.1.4 Education

For the study group, 10.9% of the study participants did not have any formal education; 38% had between Grade 1 to Grade 7 (i.e. primary school); and 47% had been to high school (i.e. Grades 8 – 12). Only 4% of those interviewed had a tertiary education. However, for each mine there were marked differences (refer to Table 4.1.4).

The majority of hostel dwellers had at least a primary school qualification whereas the non-hostel dwellers appeared to have at least a high school qualification. The different level of education among hostel dwellers and non-hostel dwellers is significant (p=0.045). In the age group 26 to 35 years, 5% of the hostel dwellers have no form of education (compared to 2% of non-hostel dwellers) (p=0.002), while 49% of non-hostel dwellers

have tertiary education compared to 17% of hostel dwellers. In mineworkers aged >55years, 67% of hostel dwellers had only been to primary school (compared to 17% of non-hostel dwellers) while 17% of non-hostel dwellers had a tertiary education. No hostel dwellers in this group had a tertiary education.

Table 4.1.4: Distribution of hostel and non-hostel dwellers by level of education (percent)

	No schooling (%)		Primary School (%)		High School (%)		Tertiary education (%)	
	Non-hostel	**Hostel**	**Non-hostel**	**Hostel**	**Non-hostel**	**Hostel**	**Non-hostel**	**Hostel**
Quarry 1	**5**		**32**		**36**		**27**	
Manganese Mine	**10**	**5**	**23**	**42**	**61**	**47**	**7**	**5**
Diamond Mine	**21**		**46**		**29**		**4**	
Coal Mine 1	**4**	**4**	**36**	**52**	**60**	**44**		
Coal Mine 2	**14**		**46**		**38**		**2**	
Quarry 2	**18**		**50**		**32**			
Platinum Mine	**4**	**19**	**25**	**35**	**60**	**42**	**6**	**4**
Gold Mine 1		**12**		**51**	**100**	**36**		
Gold Mine 2	**7**	**9**	**40**	**41**	**53**	**47**		**3**
Iron Mine			**23**	**24**	**70**	**71**	**8**	**6**
Overall	**11.6**	**9.86**	**36.4**	**40.38**	**32.5**	**38.97**	**19.43**	**10.80**

4.2 Food allowances and money spent by mineworkers

Table 4.2 gives the average amount of money spent by hostel and non-hostel dwellers on food, transport and accommodation. Non-hostel dwellers spend between R570 and R2 303 on food, transport and accommodation, which was between 20% and 59% of their salary. Hostel dwellers, on the other hand, rarely paid for transport and housing. However, 64% admitted to preparing food in their rooms. Hostel dwellers spend between R214 and R1 068 on food, accommodation and/or transport, which was about 7% to 21% of their salary. (Please note: the percentage was calculated on salaries provided by the company before deductions.)

Table 4.2: Amount of money spent on food, accommodation and transport by hostel and non-hostel dwellers

	AVERAGE SALARY PER MONTH (R)	FOOD (R)		ACCOMMODATION (R)		TRANSPORT (R)		TOTAL SPENT (R)	
		Non-hostel	Hostel	Non-hostel	Hostel	Non-hostel	Hostel	Non-hostel	Hostel
Quarry 1		**788**		**1042**		**473**		**2 303**	
Manganese Mine	5 080	**760**	**600**	**284**	**300**	**435**	**168**	**1 479**	**1 068**
Diamond Mine	5 236	**530**		**325**		**212**		**1 067**	
Coal Mine 1	3 213	**654**	**320**	**237**	**68**	**200**		**1 091**	**388**
Coal Mine 2		**599**		**177**		**484**		**1 260**	
Quarry 2	2 070	**763**		**135**		**311**		**1 209**	
Platinum Mine	4 262	**553**	**289**	**505**		**313**		**1 371**	**289**
Gold Mine 1	4 314	**400**	**243**	**150**		**20**		**570**	**243**
Gold Mine 2	2 800	**515**	**214**	**206**		**235**		**956**	**214**
Iron Mine	8 240	**780**	**416**	**302**	**151**	**58**	**20**	**1 140**	**587**

4.3 Nutrition and accommodation

KEY FINDINGS (SECTION 4.3)

- In the study sample, 67% of the non- hostel dwellers stayed in houses built from bricks, 14% stayed in flats, and 30% stayed in informal settlements (shacks).
- Of the hostel dwellers interviewed, 92% were staying in a single-sex room, 6% were staying in single quarters, and 2% were in family quarters.
- Approximately 5% of the hostel dwellers interviewed reported that they never ate at the hostel kitchen, 15% ate one meal per day, 55% ate two meals per day, and 26.4% ate three meals at the hostel kitchen
- Although food preparation in the hostel rooms was strictly prohibited, except at one of the gold mines, 64% of the hostel dwellers admitted to preparing food in their rooms
- The percentage of non-hostel dwellers who did not share a room was 9.3% compared to 7% of the hostel dwellers, 58% had one person with whom they shared a room.
- The percentage of hostel dwellers who had seven or more people sharing a room with was 54%, 20% had 11 people sharing a room with them, and 9% had more than 11 people sharing a room with them.
- Buses appeared to be the main form of transport for non-hostel dwellers (36%), but also used taxis (21%), walked (13%), or used their personal car (10%) to get to work.
- Hostel dwellers' main form of transport was walking (51%) and mine transport (21%).
- Fifty percent of hostel dwellers took less than 10 minutes to get to work compared to 13% of non-hostel dwellers.
- Sixty percent of non-hostel dwellers took more than 20 minutes to get to work; of these 18% took over an hour.

4.3.1 Non-hostel dwellers

In the study sample, 67% of the participants living out stayed in houses built from bricks, 14% stayed in flats, and 30% stayed in informal settlements (shacks). Cooking facilities were available to 97% of the non-hostel dwellers. Electricity was used to cook food by 85% of the mineworkers; 3% used gas and 12% used paraffin. Fridges were available to 69% of the study participants. In the case of 54% of the non-hostel dwellers, food was prepared by the mineworker's partner, while 41% prepared food themselves.

4.3.2 Hostel dwellers

Of the hostel dwellers interviewed, 92% were staying in a single-sex room, 6% were staying in single quarters, and 2% were in family quarters. Mineworkers staying in the family quarters (i.e. the conversion of single-sex rooms into flats) at the Diamond Mine and Coal Mine 2 were considered to be non-hostel dwellers since they did not have access to hostel food. In order to obtain food from the hostel, 9.5% of the hostel dwellers were required to purchase a meal ticket (or coupon), 90.5% were required to 'swipe' their identification cards in order to get into the kitchen. Approximately 5% of the hostel dwellers interviewed reported that they never ate at the hostel kitchen, 15% ate one meal per day, 55% ate two meals per day, and 26.4% ate all three meals at the hostel kitchen. Although food preparation in the hostel rooms was strictly prohibited, except at one of the gold mines, 64% of the hostel dwellers admitted to preparing food in their rooms. Repeated exposure to foods results in the development of monotony (Siegal, et al., 1958). In the scientific literature, this is known as "stimulus satiation" (Glanzer, 1953). This is defined as lowered acceptance of a food as a function of the number of times an item of food is consumed. Monotony then occurs, across a period of time following frequent exposures as occurs with the hostel menu. Rolls and de Waal (1985) demonstrated that long periods (6 months) of eating the same foods by refugees resulted in reduced liking and a decrease in willingness to eat these foods. Therefore increasing number of hostel dwellers are cooking their own meals.

4.3.3 Hostel dwellers and non-hostel dwellers

The percentage of mine workers who did not share a room was 9.3% of the non-hostel dwellers compared to 7% of the hostel dwellers. Fifty-eight percent of non-hostel dwellers had one person with whom they shared a room compared to 13% of hostel dwellers. Ten percent of the non-hostel dwellers had more than four people sharing a room with them. This was in comparison with hostel dwellers, where 14% had seven people sharing a room with them, 20% had 11 people sharing a room with them, and 9% had more than 11 people sharing a room with them.

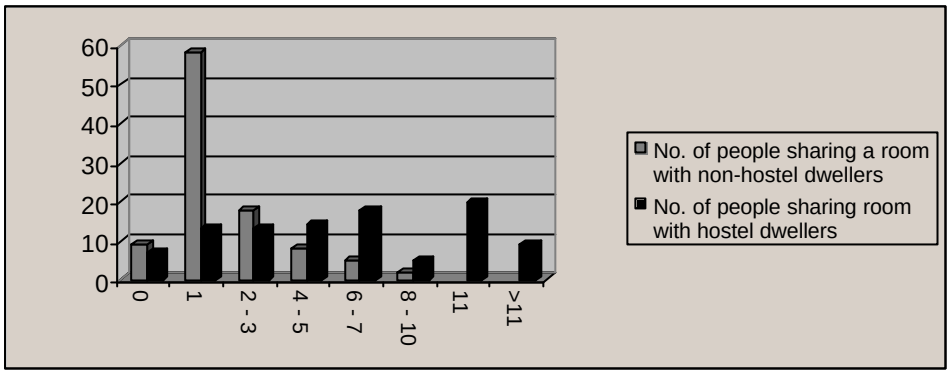


Figure 4.3.3: Number of people sharing a room with hostel and non-hostel dwellers

Buses appeared to be the main form of transport for non-hostel dwellers, with 36% of non-hostel dwellers using a bus compared to 26% of hostel dwellers. Non-hostel dwellers also used taxis (21%), walked (13%), or used their personal car (10%) to get to work. In contrast, hostel dwellers' main form of transport was walking (51%) and mine transport (21%).

Hostel dwellers staying 1 km or less from the shaft represented 36% of all hostel dwellers interviewed, with 18% staying 2-5 km from the shaft and 38% staying 6-10 km away. Only 8% were further than 10 km from work. As for non-hostel dwellers, 22% stayed 5 km or less from work, 27% stayed 6-9 km from work, 27% stayed between 10 and 39 km from work, and 24% stayed more than 40 km away from work.

The time taken to travel from the place of accommodation to work varied for hostel and non-hostel dwellers. Fifty percent of hostel dwellers took less than 10 minutes to get to work compared to 13% of non-hostel dwellers. Sixty percent of non-hostel dwellers took more than 20 minutes to get to work; of these 18% took over an hour.

4.4 Mine workers' diet

KEY FINDINGS (SECTION 4.4)

- The majority of hostel dwellers had two meals a day compared to non-hostel dwellers, who had two to three meals a day.
- 41% of non-hostel dwellers reported never eating before going to work while 73.5% of hostel dwellers reported that they always eat/drink something before they go to work.
- Fifty seven percent of non-hostel dwellers always take something to eat to work as opposed to 38% of hostel dwellers.
- 23% of non-hostel dwellers reported getting hungry during the shift as opposed to 36% of hostel dwellers.
- On average, 814 ml of fluid was consumed on an eight-hour shift by the mineworkers participating in the study.
- An average of 43% of the total study population did not take anything to eat to work.
- The food consumed during mid-shift feeding by the majority of mineworkers was
- Five reasons given for not eating during work were:
    - The participants were not in the habit of taking food to work
    - They did not have the time to eat
    - Insufficient resources, either money or food
    - 'Dirty, dusty' working conditions
    - Not have sufficient time to prepare food to take underground
- Pap and meat were the two most favourite foods among the mineworkers, at 50.9% and 39.1% respectively
- The majority of hostel dwellers at all 7 mines were very disappointed in the food served at the hostel kitchen.
- Main reasons cited were:
    - Lack of variety
    - Method of cooking poor
    - Lack of training of Kitchen staff
    - Food not being fresh
    - Certain items on the menu would be finished (especially fruit and vegetables) if they arrived late from a shift
    - Suggestions made to Food committee were not taken seriously

4.4.1 Eating habits

The majority of hostel dwellers had two meals a day compared to non-hostel dwellers, who had two to three meals a day. (See Figure 4.4.1) However, 41% of non-hostel dwellers reported never eating before going to work while 73.5% of hostel dwellers reported that they always eat/drink something before they go to work. This could be because of the distance and time it takes the non-hostel dweller to get to work in comparison to the hostel dweller.

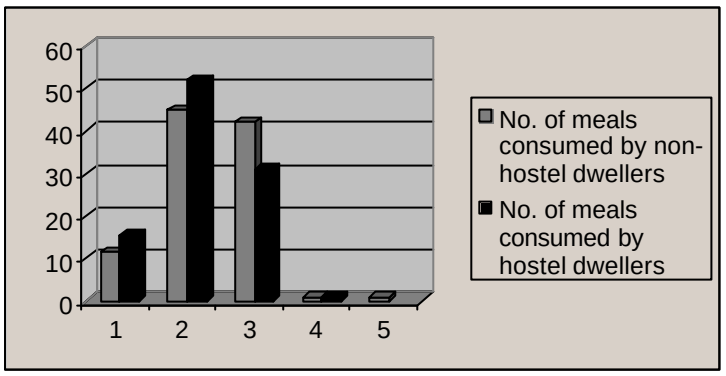


Figure 4.4.1: Percentage of meals consumed on average by hostel and non-hostel dwellers

Fifty seven percent of non-hostel dwellers always take something to eat to work as opposed to 38% of hostel dwellers. As for being hungry at work, only 23% of non-hostel dwellers reported getting hungry as opposed to 36% of hostel dwellers. This may be because non-hostel dwellers are more in the habit of taking food with them to work, whereas hostel dwellers are not allowed to or do not have the option of taking a food pack from the hostel kitchen.

Smoking and alcohol consumption habits were similar for hostel and non-hostel dwellers as shown in Table 4.4.1.1.

Table 4.4.1.1Percentage of hostel dwellers and non-hostel dwellers smoking and drinking

	HOSTEL		NON-HOSTEL	
	Average no. of cigarettes	**(%)**	**Average no. of cigarettes**	**(%)**
SMOKING	**5.6**	**31**	**6.7**	**31**
EX-SMOKER	**11.3**	**12**	**11.5**	**14**
ALCOHOL		**40**		**39**

The number of cigarettes smoked by hostel dwellers and non-hostel dwellers is seven and eight cigarettes per day respectively. Hostel dwellers appear to have been smoking for longer than non-hostel dwellers, but this may be because hostel dwellers are slightly older than non-hostel dwellers.

As regards alcohol consumption, hostel dwellers consumed only beer over the week, with an average of 8.2 l of beer being consumed over the week by the hostel dweller compared to 46 L consumed by the non-hostel dweller. This may be because beer is more accessible to hostel dwellers, with many of the hostels having a bar within the hostel grounds. Hostel dwellers also have more time to drink than non-hostel dwellers do since they do not travel far to get home and their food is prepared for them when they get to the hostel.

Table 4.4.1.2 gives the average amounts of beer, wine and spirits consumed over the weekend by hostel and non-hostel dwellers.

Table 4.4.1.2: Type and average amount of alcohol consumed by hostel and non-hostel dwellers over the weekend.

		BEER	**WINE**	**SPIRITS**
FRIDAY	**HOSTEL**	**6.1 l**	**1.1 l**	**357 ml**
	NON HOSTEL	**3.7 l**	**1.8 l**	**1.5 l**
SATURDAY	**HOSTEL**	**4 l**	**2.3 l**	**357 ml**
	NON HOSTEL	**2.8 l**	**1.6 l**	**1.3 l**
SUNDAY	**HOSTEL**	**2.8 l**	**2 l**	**375 ml**
	NON HOSTEL	**3 l**	**1.3 l**	**421 ml**

Hostel dwellers drink excessively on Friday and progressively less over the rest of the weekend. Non-hostel dwellers also drink the most on Friday but drink more than hostel dwellers on Sunday. Non-hostel dwellers drink more wine and spirits than do hostel dwellers.

4.4.2 Mid-shift feeding

On average, 814 ml of fluid was consumed on an eight-hour shift by the mineworkers participating in the study (Table 4.4.2.1). Mineworkers in the gold mines consumed over a litre of water per shift. The mineworkers at the Iron mine consumed close to two litres of water per day since the mine is open cast and the temperatures during the week that the interviews were conducted were over 35°C every day. The two quarries are also open cast but are in different areas, with Quarry 2 having a warmer environment. At the Platinum Mine, which is also in a warmer environment (20?C – 32.5?C wet bulb, similar to the gold mine), the mineworkers only consumed 500 ml of water per day on average (Figure 4.4.2).

Table 4.4.2.1: Mineworkers' average consumption of fluid consumed during work

	Fluid (ml)
QUARRY 1	360.45
MANGANESE MINE	313.34
DIAMOND MINE	544.71
COAL MINE 1	621.80
COAL MINE 2	458.60
QUARRY 2	922.27
PLATINUM MINE	505.49
GOLD MINE 1	1196
GOLD MINE 2	1279
IRON MINE	1947.71
AVERAGE	**814.94**

An average of 43% of the total study population did not take anything to eat to work. This was especially seen in the 'dusty, dirty mines', i.e. 77% of the mineworkers at the Platinum Mine, 68% of mineworkers at the gold mines and 56% of mineworkers at the coal mines did not take food underground. In contrast, the 'cleaner mines' and open cast mines had more mineworkers taking food to work. This could also be because food was more accessible on the surface than underground.

The food consumed during mid-shift feeding by the majority of mineworkers was pap and bread (37%), red meat and chicken (23%). Surprisingly, fruit and vegetables were also

very popular, at 14% and 19% respectively. Other food items consumed and the percentage consumed are shown in Table 4.4.2.2.

Reasons given for not eating during work were numerous. However, five main reasons are worth mentioning. The most frequently cited reason, was that the participants were not in the habit of taking food to work. Many said that they ate before or after work and did not get hungry when they were at work. They claimed that if they did get hungry they would buy food at work. Interestingly, many said that they would not take food to work if they were working the night shift. Unfortunately, this was not probed further. The second most frequent reason given was that they did not have the time to eat. Often they were moving around a lot or were far from where they could keep the food, and they therefore did not have the time to get to the food or even to eat it. The third main reason was insufficient resources, either money or food. Many felt that it was not worth the expense to buy more food for work; others admitted that they did not have the money or extra food to take to work. The fourth reason concerned working conditions. Many felt that the working environment was too dirty or dusty and that there were no facilities to store the food or even a clean area in which to eat the food. The last main reason was that they did not have sufficient time to prepare food to take underground.

Mineworkers also mentioned that they were not allowed to take food underground or that because they saw others not taking food underground they also did not take food. Others expressed a genuine ignorance as to which food they could take underground, that is a real concern in terms of lack of attention to nutrition, knowledge about nutrition and communication between managers and labourers.

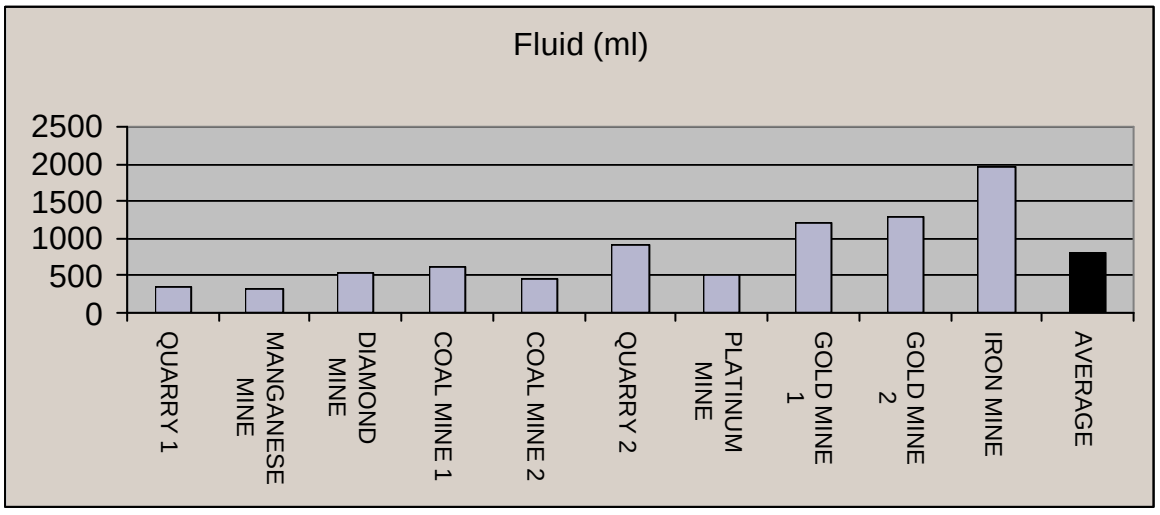


Figure 4.4.2: Mineworkers' recorded average consumption of fluid consumed during work at the different mines

Table 4.4.2.2: Mineworkers' consumption of different types of food consumed during work

	Bread (%)	Breadspreads (%)	Pap (%)	Red meat (%)	Cold meat (%)	Chicken (%)	Fish (%)	Fruit (%)	Vegetables (%)	Samp (%)	Rice (%)	Dairy (%)	Eggs (%)	Junk food (%)	Nothing to eat during the shift (%)
QUARRY 1	50.00	27.27	77.27	50.00	27.27	50.00	4.55	27.27	45.45	4.55	9.09	13.64	9.09	9.09	0.00
MANGANESE MINE	84.00	24.00	46.00	34.00	24.00	10.00	6.00	8.00	16.00	4.00	14.00	12.00	14.00	8.00	8.00
DIAMOND MINE	48.08	11.54	57.69	34.62	3.85	36.54	1.92	30.77	15.38	5.77	9.62	3.85	0.00	0.00	11.54
COAL MINE 1	22.00	2.00	18.00	8.00	10.00	16.00	0.00	6.00	12.00	0.00	8.00	2.00	6.00	2.00	50.00
COAL MINE 2	22.00	8.00	14.00	2.00	4.00	10.00	2.00	4.00	14.00	2.00	8.00	0.00	6.00	0.00	62.00
QUARRY 2	22.73	0.00	90.91	45.45	0.00	59.09	0.00	13.64	59.09	4.55	13.64	0.00	4.55	4.55	4.50
PLATINUM MINE	10.58	2.88	10.58	7.69	3.85	5.77	0.00	0.00	5.77	0.96	3.85	1.92	3.85	1.92	76.90
GOLD MINE 1	22	0	2	2	0	8	0	6	8	2	2	0	4	0	66.00
GOLD MINE 2	20	0	4	4	4	4	0	10	4	0	4	2	10	4	70.00
IRON MINE	64.58	14.58	47.92	39.58	22.92	35.42	10.42	41.67	10.42	10.42	31.25	6.25	22.92	6.25	4.08
AVERAGE	**36.60**	**9.03**	**36.84**	**22.73**	**9.99**	**23.48**	**2.49**	**14.73**	**19.01**	**3.42**	**10.34**	**4.17**	**8.04**	**3.58**	**43.57**

4.4.3 Knowledge, attitudes and practices (KAP)

Table 4.4.3, indicates the most liked and disliked foods as volunteered by the study participants. The questions were opened ended. Study participants were asked to list the foods they liked and disliked.

Table 4.4.3: Lists of foods enjoyed and disliked by mineworkers

	FOODS MINEWORKERS ENJOY		FOODS MINEWORKERS DO NOT LIKE	
	n	%	n	%
Pap	245	50.9	53	11.0
Rice	146	30.4	42	8.7
Stamp	59	12.3	42	8.7
Meat	188	39.1	56	11.6
Chicken	135	28.1	14	2.9
Fish	26	5.4	23	4.8
Mutton	25	5.2	1	0.2
Offal	4	0.8	6	1.2
Pork	12	2.5	32	6.7
Veggies	42	8.7	12	2.5
Cabbage	34	7.1	27	5.6
Beans	31	6.4	18	3.7
Potatoes	24	5.0	12	2.5
Spinach	23	4.8	1	0.2
Salads	21	4.4	0	0.0
Tomatoes	11	2.3	5	1.0
Fruit	41	8.5	0	0.0
Banana	18	3.7	3	0.6
Apples	17	3.5	0	0.0
Oranges	4	0.8	0	0.0
Amasi	13	2.7	0	0.0
Milk	36	7.5	2	0.4
Bread	30	6.2	11	2.3
Morogo	11	2.3	2	0.4
Eggs	25	5.2	6	1.2
Fatty food	0	0.0	16	3.3
Soup	0	0.0	16	3.3
Mealie rice	2	0.4	19	4.0
Curry	0	0.0	7	1.5

Pap and meat (includes chicken and red meat) were the two most favourite foods among the mineworkers, at 50.9% and 39.1% respectively. Those who stated that they did not like pap (11%) often referred to the way the pap was prepared, i.e. 'styf' /stiff pap or sour porridge. Rice was a favourite among mineworkers (30% liked it compared to 9% who did not) and samp and mielie rice were not that popular. Meat often

referred to all types of meat, including chicken and mutton, but not pork. As far as possible, this was recorded separately so that meat referred to beef. More mineworkers did not like pork and offal than those that did. Fish in tins was not very popular and those who liked fish often referred to fresh fish.

Fruit and vegetables were also popular, at 9% for both hostel and non-hostel dweller. However, these were not nearly as popular as the pap and the meat. Among the vegetables, cabbage, spinach and morogo were mentioned often. As regards fruit, bananas, apples, and orange were mentioned often. The different types of melons were not very popular.

Milk, bread and eggs were also mentioned often, at 7.5%, 6% and 5% respectively. Eggs were mentioned often in the 24-hour recall. It was also found that 8% of the study population ate eggs during work. Yet eggs were only mentioned by 5% of the study population as a food they enjoyed. Those that stated they liked bread, preferred brown bread to white bread and those that did not like bread mentioned white bread more often. Tomato sauce, mayonnaise, 'Kentucky Fried Chicken' and 'MacDonald's' were also mentioned as food enjoyed.

In general, an answer to the question, which food was not liked by the mineworker, was not always given, with 25% stating they liked all food when asked which foods they did not like. Other comments referred to food at the hostel or food sold at the taxi ranks as poor, without specifying which food/meals were being referred to. Some participants commented that they did not enjoy "women's food", and when probed further mentioned fruit and vegetables. Their perception was that fruit and vegetables were of little value, as it did not fill them up.

When asked which food they felt was healthy, a list very similar to food enjoyed was produced. Reference to food preparation again was emphasised with comments to the effect that 'well cooked meals' or 'food cooked by his wife' was considered to be healthy food. Among the non-hostel dwellers, 14% use vitamins and 19% use traditional medicine compared to hostel dwellers where 12% use vitamins and 31% use traditional medicine. The researchers noted that traditional medicine and vitamins were not used regularly. About 1% of both hostel and non-hostel dwellers were vegetarians.

Mineworkers felt that the food they were eating enabled them to do their work well, with 91% expressing the belief that they were eating the correct food. However, 82% of hostel dwellers as opposed to 98.5% of the non-hostel dwellers felt they were eating correctly ($p<0.05$).

There was also a significant difference between the ease of access to food for hostel dwellers and for non-hostel dwellers ($p<0.05$). Among the hostel dwellers, 51% claimed that access to food when hungry was difficult compared to 23% of non-hostel dwellers. Not surprisingly, the main reason given was that 37.5% of the mineworkers did not take food to work. Other reasons given were that there were no food outlets / canteens available at work, or that they did not have enough money to bring extra food. Some of the hostel dwellers complained that the canteen was closed at night or that certain kinds of food were finished by the time they get back from their shift.

4.4.4 Hostel kitchen

Only current hostel dwellers were asked to rate the hostel kitchen, and they were asked to rate the taste, smell, appearance and variety of the food being served at the different hostel kitchens. Table 4.4.4 gives a summary.

Table 4.4.4: Hostel food rating by hostel dwellers

	Good	Acceptable	Poor
Taste	**9%**	**16%**	**75%**
Smell	**11%**	**20%**	**69%**
Appearance	**12%**	**17%**	**71%**
Variety	**12%**	**17%**	**71%**

The majority of hostel dwellers at all 7 mines were very disappointed in the food served at the hostel kitchen. The study team occasionally agreed with their complaints especially the taste of some of the food. The hostel dwellers rating is confounded by dietary monotony and having no “control” over the diet as is frequently seen in

institutionalised populations[5]. Research done by the U.S. army confirmed this. In one study (Kamen, et al., 1961; Pelchat, et al., 2000) well-nourished army men on monotonous diets reported cravings for foods other than those provided. Fourteen percent of the hostel dwellers interviewed made suggestions of food that could be included in the menu. These included; milk, vegetables, greater variety of food, breakfast cereals, cheese, eggs, spaghetti and mince meat. One hostel manager demonstrated previous menus negotiated, which had included most of these options, but because they made the meal more expensive, mineworkers were not prepared to pay more, and the hostel kitchen resorted to the current menu.

Thirty one percent of hostel dwellers felt that the method of cooking required improvement. Apart from one of the hostel kitchens where frozen food was 'thawed' in hot water several times to defrost before cooking the same morning, most food preparations at the hostel kitchens looked standard, although this is possibly by western standards. It was beyond the scope of the study to compare how food prepared by each kitchen differed from food prepared traditionally by mineworkers.

Some of the suggestions/complaints made are as follows:
' Pap too hard'
'Improve taste of food'
'Clean vegetables'
'Cook rice with too much water'
'Don't like the mealie meal system of cooking'

A few of the participants (2%) requested that the kitchen be outsourced. They were under the impression that the cooks would be better trained. However, at the kitchens that were outsourced to subcontractors, the cooks were not necessarily better trained. Five percent of the mineworkers suggested that they should cook for themselves. They suggested that the company should either provide them with money or raw ingredients or allow them to cook in their rooms.

Lack of training of kitchen staff was another complaint (5%). Some felt that only women should be employed. There was a perception that the kitchen staff was made up of injured underground mineworkers who were relocated to a surface job in the

[5] Union representative mentioned at the workshop that if he woke in the morning wanting a pizza and was served something else at the hostel kitchen…he would complain.

kitchen. At many of the kitchens this did occur, but most kitchens had stopped the practice after 1994. Previous cooks whose training could not be confirmed often taught staff, and often the addition of salt or sugar was left to the discretion of the cook, with results that the study team agreed were distasteful. At only one mine was there a permanent Food Service Manager who was actively involved in the running of the kitchen, which included training in food preparation.

Some hostel workers (4%) complained about food not being fresh. At all hostel kitchens there was a system to date the stock received from the suppliers to ensure that 'old' stock was used first. Only at one mine was most of the stock (i.e. meat and vegetables) received and used the same day. This mine was closer to most food distributors and farms compared to other mines that needed to keep stock for longer periods. Unfortunately, especially with frozen stock, the dates of reception from suppliers were not always clear and the potential for old stock to be issued last could not be excluded.

Many mineworkers complained that if they arrived late for a meal, certain items on the menu would be finished (especially fruit and vegetables). Batch cooking was not practised at many of the kitchens and implementation of this method could possibly prevent such an occurrence. Batch cooking is essential for quality food production. Quantities for a thousand portions should be used for ordering only and not for preparing food. Best quality baked goods are obtained by mixing batches for 50 portions. Best quality stewed, simmered and braised products are obtained by not exceeding 200 portions at a time. It is strongly recommended that the cooking process should rather be repeated than overloading equipment or making use of extremely large equipment. Some of the comments from the mineworkers illustrated their concern.

> ' Lack of vitamins in food'
> 'Food kept warm will make us ill'

A hostel manager commented that mineworkers always complain because they fear that if they do not the standard will drop. A union representative suggested that if he woke up wanting a pizza, but was served good pap and meat instead, he would complain because his desire for pizza was not met. This would support the lack of

choice and monotony as discussed being an important factor in the consideration of perceived quality and an enormous challenge for institutional feeding.

Other suggestions and complaints from mineworkers include:

‘I would like 3 meals’

‘Cook healthy food for us because we work’

‘Don’t know what I would suggest to change the food but want it changed’

‘Don’t like seeing flies in the kitchen’

‘I suggest that tonight they must make us burgers’

‘The pap is like cement’

‘Send someone to check what type of food is being cooked’

‘Menu should be changed regularly’

Of concern, 26% of the hostel dwellers did not have any suggestions. This may be because 10% of the hostel dwellers felt that it was no use making any suggestions because suggestions made to the feeding committee previously were not implemented or even considered according to the hostel dwellers.

4.5 Nutritional content of food consumed

KEY FINDINGS (SECTION 4.5)

- Mean energy intakes varied between 5 039 kJ and 11 361kJ.
- Most of the mean values for protein intake were above the RDA for protein intake at all 10 mines
- The results of this study showed that the mean fat intakes varied between 17% E and 27% E. .
- The dietary cholesterol intakes of mineworkers were in line with the guideline for cholesterol intake
- The intakes found in this study were much higher than intakes reported for South African men following a Western type of diet, in whom carbohydrate intakes varied between 45% E and 47% E (Wolmarans, et al., 1988). In our study it varied from 52% to 64%.
- Dietary fibre intakes were found to be low.
- Micronutrient intakes were in general low, and of special concern were the very low intakes of vitamins A and C.
- There are indications that the dietary intakes of mineworkers living outside the hostels were more favourable than those who live in the hostels.
- Mineworkers who lived outside the hostels had significantly higher energy, total fat, dietary cholesterol and total carbohydrate intakes
- Vitamin A and vitamin C intakes were also significantly higher in those who live outside than in those living in the hostels, although in both groups mean intakes were low.

Diet plays an important role in health and disease. In order to determine the dietary intake of a population, different methods can be used. Each of the available methods has advantages and disadvantages and these had to be taken into account when choosing a suitable method for this study.

In order to meet the aims of this study and to overcome certain logistical limitations, it was decided to use the 24-hour recall method for the collection of dietary data. A study-specific validated food frequency questionnaire (FFQ) was not available for the collection of dietary data in this study. In addition, piloting of a FFQ in the study population showed that the collection of dietary data by means of this method did not work. Using this method, information on food intake is collected for the 24-hour period

that precedes the interview. This method allows for the description of the dietary intake of the population studied, but not for the evaluation of the dietary risk profile of an individual. It is therefore possible to indicate whether a population is nutritionally at risk for diseases, but it is not possible to indicate whether a particular individual is at risk in terms of his dietary intake. This section deals with the energy, macronutrient and micronutrient intake of the study population. The results in this section should be interpreted against the background of limitations in dietary research methodology. In this study it was also not possible to select a random sample for the collection of dietary intake data. A convenience sample was drawn (see Section 4) and the results may therefore not be a reflection of the diets of all the mineworkers at the mine studied.

4.5.1 Energy and macronutrient intake

4.5.1.1 Energy intake

The mean and standard deviation (sd) for reported energy intakes at each mine are shown in Table 4.5.1.1 for participants at the 10 mines. Mean energy intakes varied between 5 039 kJ and 11 361kJ. The mean energy intake recommended for men from 25 to 50 years of age is approximately 12 000 kJ for those doing light to moderate activity (Subcommittee on the Tenth Edition of the RDAs, 1989). It is, however, recommended that the energy needs for those who have heavy activity patterns be adjusted to 2.0 times resting energy expenditure (REE). Using this as a guideline, the recommended energy intakes for light to moderate activity (REE x 1.6) and for heavy activity patterns (REE x 2.0) were calculated and are presented in Table 4.5.1.1 (Subcommittee on the Tenth Edition of the RDAs, 1989). It is clear from the results that the mean intakes at all the mines were low when compared to the reference figures. The COMRO report (Van Rensburg, et al., 1991) showed that the energy expenditure of mineworkers varied between 8 848 kJ for mine workers involved in cleaning up operations during the night shift (511 minutes) to 10 694 kJ for a drill assistant (575 minutes) (Van Rensburg, et al., 1991).

Several factors may be responsible for the low energy intakes. It is known that the 24-hour recall dietary method tends to underestimate dietary intake (Cameron, et al., 1988). A study in Sweden, using repeated 24-hour recalls for the collection of dietary data has shown that under-reporting of energy intake in men could be as high as 61% (Johansson et al., 2001). There is often an underreporting of alcohol intake, while people who are overweight also tend to underreport their dietary intake. The low energy intakes reported may, however, be a true reflection of what the miners

consumed on the day when the dietary data were collected because some of the mineworkers reported a very high energy intake as can be seen from the maximum energy intakes reported in Table 4.5.1.1. Nevertheless, when the ratio of recorded energy intake (EI) to estimated basal metabolic rate (BMRest) was calculated, and compared to cut-off values recommended by Goldberg et al (1991), under-reporting of energy intakes was present in 8 of the 10 mines.

Table 4.5.1.1: Mean and SD of age, BMI and energy intake of mineworkers

	Mines[a]									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Number (n)	49	50	22[b]	22[b]	50	49	50	103	48	50
Age										
Mean	42.5	47.4	42.3	42.5	39.9	40.3	44.6	41.5	37.5	39.0
SD	6.6	8.0	10.2	11.1	8.4	9.2	8.0	9.1	10.2	7.9
BMI										
Mean	25.4	25.5	25.2	25.0	24.1	25.3	25.3	27.4	24.9	24.7
SD	4.8	5.3	4.2	4.3	3.0	5.1	5.1	5.1	3.9	3.8
Energy Intake (kJ)										
Mean	5 039	8 643	11 361	9 821	6 741	8 960	6 404	6 682	9 147	7 342
Std	3 024	4 362	5 525	3 642	3 587	3 330	2 860	3 979	3 647	3 458
Median	4 308	8 196	9 363	10 157	5 675	8 755	6 007	6 353	8 600	6 801
Min	211	1 386	5 312	3 356	1 330	1 760	2 484	562	1 615	1 399
Max	16 883	25 558	24 321	16 978	1 987	17 637	16 247	24 725	21 758	21 275
REI[c] (kJ)	11 397	11 509	11 514	11 239	11 271	11 546	11 573	11 481	11 347	11 438
REI[d] (kJ)	14 246	14 387	14 392	14 049	14 089	14 432	14 466	14 352	14 184	14 297

[a] Mines: 1= Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

[b] Sample size did not meet the requirement of 50 subjects when using the 24-hour recall; however, the sample comprised all the mineworkers at the specific mines

[c] REI: Average recommended energy intake for light to moderate classes of activity, calculated with the formula Resting Energy Expenditure (REE) x 1.6.

[d] REI: Average recommended energy intake for heavy activity patterns, calculated with the formula REE x 2.0.

Equation used for the prediction of REE = (11.6 x wt) + 879, using the age category of 30-60 years and using the body mass measured for each mine worker (Subcommittee on the Tenth Edition of the RDAs, 1989).

Mean values for body mass index (BMI, kg/(height in m)^2) are also given in Table 4.5.1.1. Normal weight is defined as a BMI of ?18 and <25 while a BMI of ?25 and <30 indicates that a person is overweight. The mean BMI at most mines was approximately 25, while at Platinum Mine the mean BMI was 27. Data could be explored further to determine whether or not miners with a high BMI had a higher reported energy intake than those with a normal BMI. At most mines, the mean BMI was approximately 25 while at Platinum Mine, the mean BMI was 27. There was no difference (p = 0.9376) between the reported mean energy intakes of those (n = 238) with a BMI <25 (7 605 kJ) compared to those (n = 246 kJ) with a BMI of = 25 (7503 kJ).

4.5.1.2 Protein intake

The mean and standard deviation (SD) for protein intakes are shown in Figure 4.5.1.2a for the participants at ten mines. Only the Coal Mine and Platinum Mine did not meet the Recommended Dietary Allowance (RDA) for protein intake (Subcommittee on the Tenth Edition of the RDAs, 1989). There was, however, a large standard deviation for protein intake indicating the large variation in the reported dietary data.

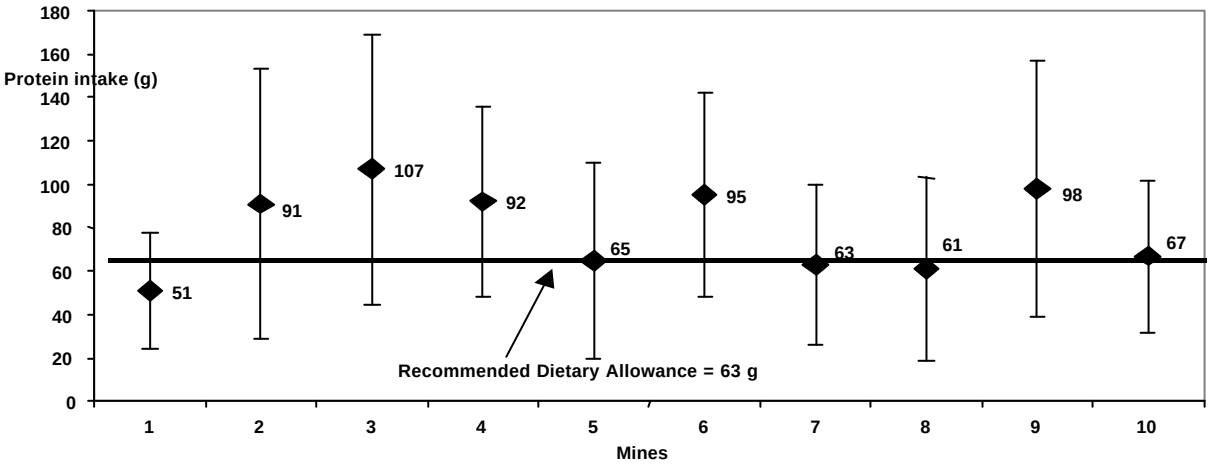


Figure 4.5.1.2a: Mean (±sd) protein intake of mineworkers compared to the recommended Dietary Allowance (1989) (n=493)

Mines: 1= Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

The low protein intake is also a reflection of low total energy intakes. However, most of the mean values for protein intake were above the RDA for protein intake. Figure 4.6.1.2b presents protein intake expressed as a percentage of energy (% E) intake. This figure shows that the mean percentage of energy from protein is in line with the prudent dietary guidelines for protein intake (15% E). In this study, protein intake varied between 15% E and 18% E. The results are similar to those of other studies, such as the study by Bourne, et al. (1993), which reported an intake of approximately 15% E in urban African men between 19 and 64 years of age (Bourne, et al., 1993).

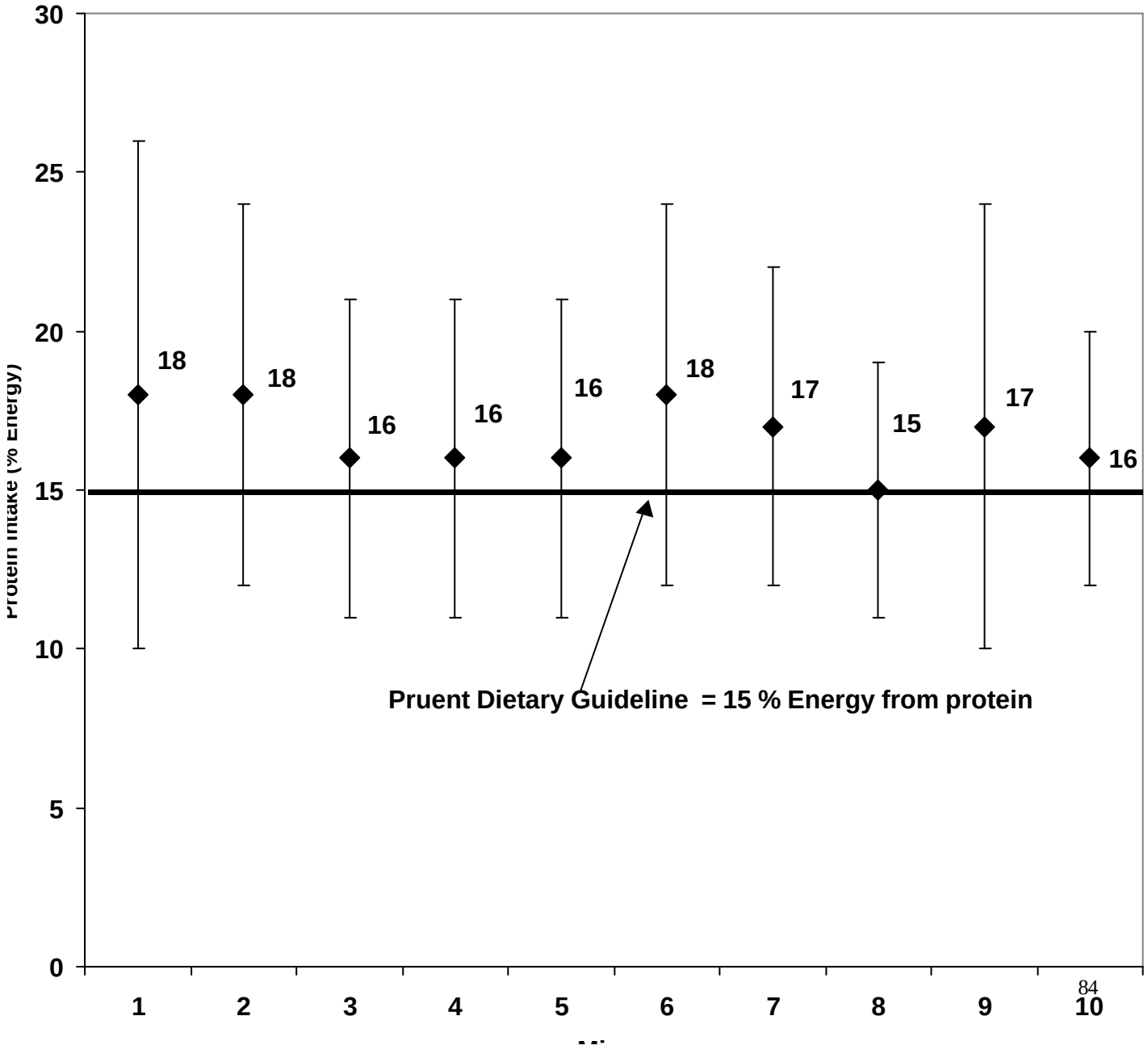
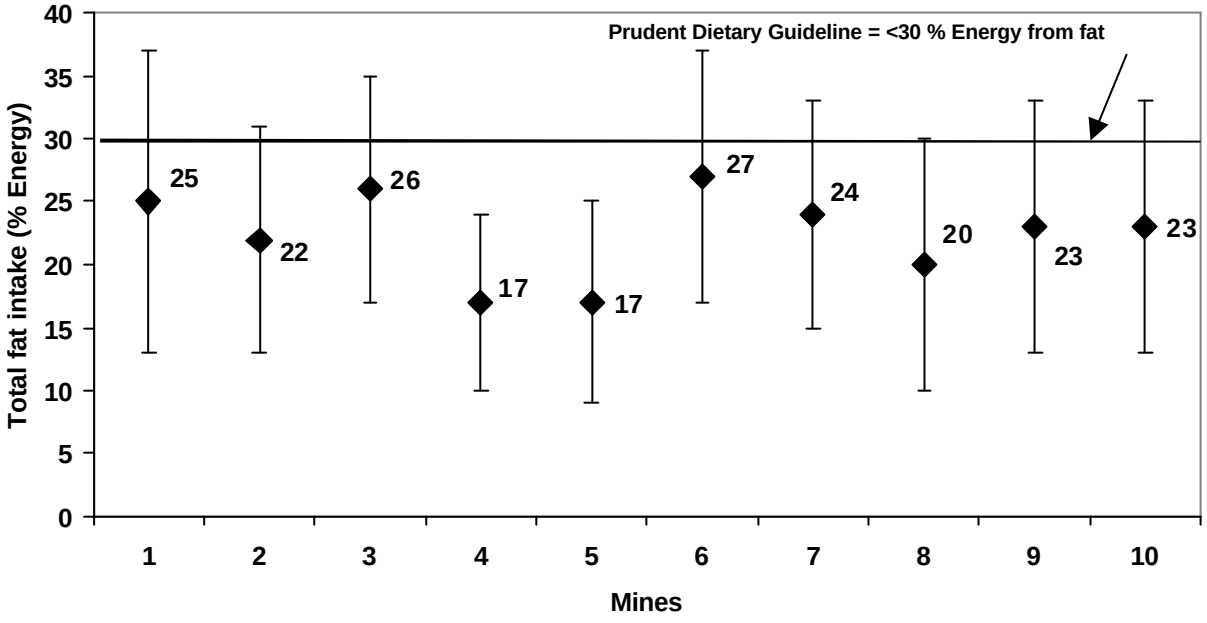


Figure 4.5.1.2b: Mean (±sd) percentage of energy from protein compared to the Prudent Dietary Guideline for protein (mineworkers, n = 493)

Mines: 1= Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold



4.5.1.3 Total fat intake

Total fat intake is shown in Figure 4.5.1.3a. A high fat intake is linked to chronic diseases of lifestyle such as coronary heart disease (CHD), high blood pressure, certain cancers and also obesity (FAO/WHO, 1994). Therefore, a guideline has been formulated for the intake of fat, and it is recommended that fat intake should not be more than 30% E. Fat intake can be as much as 35% E in active individuals who are in energy balance provided that the intake of saturated fatty acids (SFA) is not more than 10% E (FAO/WHO, 1994). A very low fat intake may, however, also be detrimental to health.

Figure 4.5.1.3a: Mean (±sd) percentage of energy from total fat compared to the Prudent Dietary Guideline for total fat (mineworkers, n = 493)

Mines: 1= Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

In two of the mines (4 and 5) mean total fat intakes were very low (17% E), while the medians for total fat intake varied between 15% E and 18% E respectively in these two mines (See Figure 4.5.1.3a.). It is recommended that at least 15% E should come from fat and that efforts should be made to ensure that individuals consuming very low fat diets be encouraged to increase their fat intake to a moderate level (20-30% E). In very low fat diets it may be difficult to meet the requirements for essential fatty acid intake.

The results of this study showed that the mean fat intakes varied between 17% E and 27% E. A study on an urban African population living in the Cape Peninsula found that total fat intake varied between 24% E and 26% E for men aged from 19 to 64 years of age (Bourne, et al., 1993). In a study on African men living in the North West Province (Macintyre, 1998), total fat intake was found to vary between 17% E and 34% E. Men from 15 to 55 years of farms had low to moderate fat intakes: (17% E to 26% E), with the lowest intake (17% E) in men 35 to 44.9 years of age (Macintyre, 1998). In the same study, men from an upper-class urban area had a total fat intake that varied between 30% E and 34% E. On a Western type diet, South African men from 20 to 64 years of age were found to consume a diet containing approximately 35% E from fat (Wolmarans et al., 1988).

Saturated fatty acids (SFA)

The mean (±sd) SFA intakes as a percentage of total energy are given in Figure 4.6.1.3b below. To prevent the development of CHD, a SFA intake of <10% E is recommended. The diet of the mineworkers was found to meet this guideline, and they were, therefore, in terms of their SFA intake not at risk for development of CHD. In other studies done on urban African men, the percentage of energy from SFA was found to be approximately 9% E (Bourne, et al., 1993).

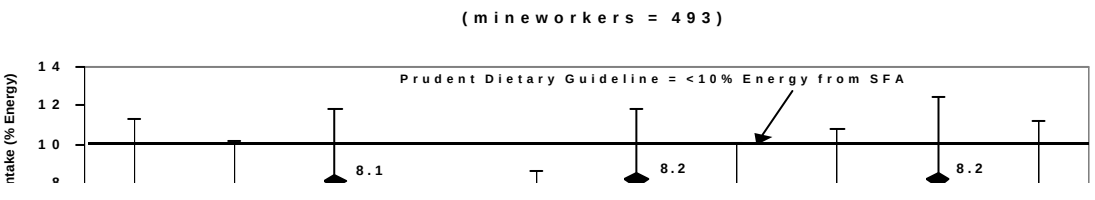


Figure 4.5.1.3b: Mean (±sd) percentage of energy from saturated fatty acids (SFA) compared to the Prudent Dietary Guideline for SFA

Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

Polyunsaturated fatty acids (PUFA), monounsaturated fatty acids (MUFA) and the dietary PUFA/SFA (P/S) ratio

In Table 4.5.1.3c, the percentages of energy from PUFA, MUFA and the P/S ratio of the diet are shown.

The study found that PUFA intake was less than 10% E, which is in agreement with the recommendation of ~10% E from PUFA. The P/S ratio of the diets was high and even higher than the ratios (0.73-0.81) reported for urban African men (Bourne, et al., 1993). The P/S ratios found in this study were also higher than those reported for African men from rural areas or farms in the North West Province (Macintyre, 1998). On a Western diet, the P/S ratio is generally low. In men following a Western type diet, the dietary P/S ratios varied between 0.48 and 0.53 (Wolmarans, et al., 1988). The prudent dietary guideline for the P/S ratio is 1 and the P/S ratios of the diets of mineworkers are, therefore, in agreement with this recommendation.

Table 4.5.1.3c: Mean (±sd) percentage of energy from polyunsaturated fatty acids (PUFA), monounsaturated fatty (MUFA) acids and the PUFA to saturated fatty acid (P/S) ratio of the diet

	Mines[a]									
	1	2	3	4	5	6	7	8	9	10
n PUFA	49	50	22	22	50	49	50	103	48	50

Mean	6.8	5.5	6.1	5.5	4.2	6.1	6.4	4.9	4.3	4.8
SD	5.0	3.6	2.8	3.9	2.9	3.6	3.8	4.6	2.9	3.1
MUFA										
Mean	9.1	7.8	9.7	5.1	5.8	9.8	8.6	6.6	8.1	8.1
SD	5.0	3.9	4.0	2.0	3.3	4.3	4.0	4.0	4.4	4.3
P/S										
Mean	1.21	1.01	0.90	1.28	1.07	0.86	1.07	1.1	0.73	0.82
SD	0.91	0.63	0.56	0.98	0.93	0.58	0.64	0.95	0.64	0.61

[a] Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

MUFA intakes were found to be satisfactory and in agreement with the requirements of a healthy diet. MUFA does not have a cholesterol elevating effect and can be regarded as neutral. It also has a cholesterol lowering effect when it replaces SFAs in the diet (Wolmarans, 1997).

4.5.1.4 Dietary cholesterol

Mean (±sd) dietary cholesterol intakes are shown in Figure 4.5.1.4. It is recommended that the intake of dietary cholesterol should be less than 300 mg/day (Wolmarans, 1997). This is especially important for those following a Western type of diet that is high in total fat. The dietary cholesterol intakes of mineworkers were in line with the guideline for cholesterol intake as can be seen from Figure 4.5.1.4. The large standard deviations for cholesterol intake are the result of the consumption of a large number of eggs or liver by some of the participants (data not shown here). Both of these foods are high in dietary cholesterol and make a significant contribution to the cholesterol intake of an individual. Some of the participants ate as many as eight eggs per day. Eggs are also an important source of both macro- and micronutrients and are a good source of protein, especially in the diets of those who cannot afford meat.

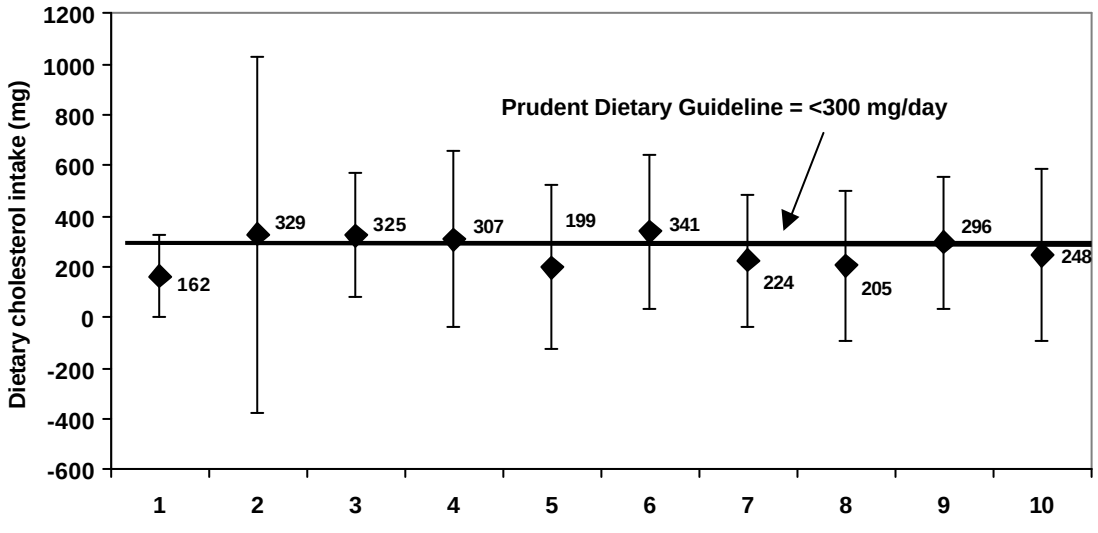


Figure 4.5.1.4: Mean (±sd) dietary cholesterol intake compared to the Prudent Dietary Guideline for cholesterol

[a] Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

4.5.1.5 Carbohydrate intake

A high carbohydrate intake is recommended as part of a healthy diet. The recommendation for carbohydrate intake is 55+ % E. Mean carbohydrate intakes of the mineworkers were high. (See Figure 4.5.1.5 below.) The intakes found in this study were much higher than intakes reported for South African men following a Western type of diet, in whom carbohydrate intakes varied between 45% E and 47% E (Wolmarans, et al., 1988).

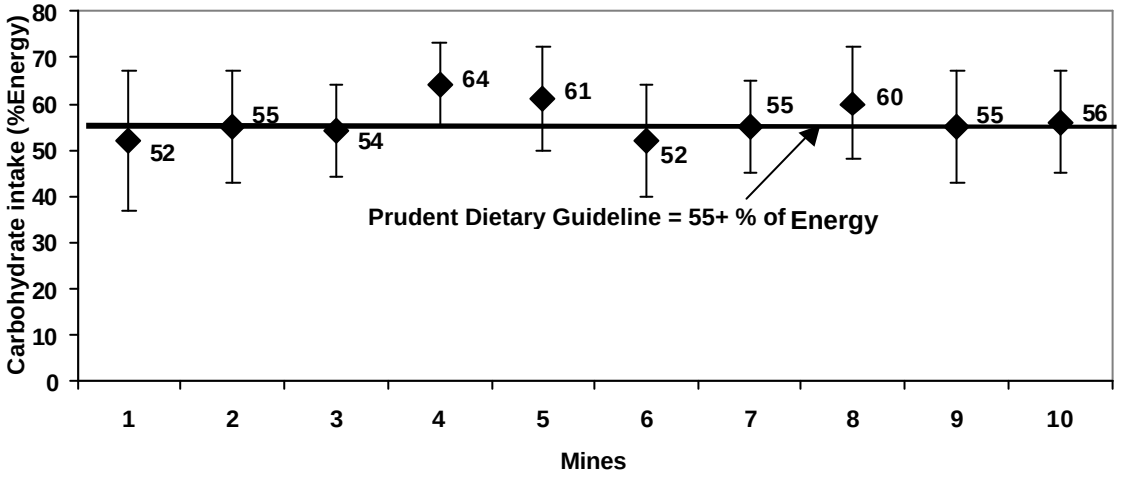


Figure 4.5.1.5: Mean (±sd) percentage of energy from carbohydrate compared to the Prudent Dietary Guideline for carbohydrate (mineworkers, n =493)

Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

Bourne, et al.'s (1993) study of urban African men living in the Cape Peninsula found that these men had a carbohydrate intake that varied between 59.2% E and 61.3% E. The findings of the study on mineworkers are in line with these findings (Bourne, et al., 1993).

4.5.1.6 Dietary fibre intake

Dietary fibre intakes were found to be low. (See Figure 4.5.1.6) Although the intakes of total carbohydrate were in agreement with the prudent dietary guidelines for carbohydrate, dietary fibre intakes were low and did not meet the guideline of approximately 30 g of dietary fibre per day (Wolmarans, 1997). The low dietary fibre intakes indicate that the main sources of carbohydrate in the diet were mainly refined carbohydrate-rich foods. Evaluation of the types of food consumed indicated that maize meal porridge formed the bulk of the diet. Maize meal porridge is not an exceptionally good source of dietary fibre and contains 0.8 g of dietary fibre per 100 g of maize meal porridge, stiff cooked (Langenhoven, et al., 1991). The consumption of other important sources of fibre in the diet, e.g. vegetables and fruit, were low (data not shown).

Figure 4.5.1.6: Mean (±sd) dietary fibre intakes compared to the Prudent Dietary Guidelines for dietary fibre (mineworkers, n = 493)

Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

4.5.1.7 Conclusions on energy and macronutrient intakes

In conclusion, the evaluation of the energy and macronutrient intakes of mineworkers showed that their energy intakes were generally low. This may indicate an underreporting of nutrient intakes, but this needs to be confirmed by further analyses of the data.

Macronutrient intakes were in line with the recommendations for a healthy diet, but there are indications that low fat intakes may be a problem at some mines. Very low fat diets may result in an inadequate intake of essential fatty acids, which are important for maintaining the structure and function of the cell membranes. Essential fatty acids are also important precursors of eicosanoids involved in many physiological processes. Those who follow a very low fat diet should be encouraged to increase fat intake to a moderate level, with an emphasis on consuming foods that contain PUFA and MUFA rather than SFA. The problem of the low dietary fibre intake may be resolved by the inclusion of more vegetables and fruit and unrefined grains in the diet .

4.5.2 Intake of micronutrients

In the interpretation of micronutrient data, the possible underreporting of food intake in this study should be taken into account.

4.5.2.1 Minerals

The mean intakes of minerals as well as the recommendations for these nutrients for men from 31 to 50 years of age are given in Table 4.5.2.1. The mean intakes for most of the minerals were below the Dietary Reference Intakes (DRI) (Trumbo, et al., 2001).

Very low mean calcium intakes were reported. Except for Coal mine 1, most of the mines met or nearly met the DRI for iron intake. In the analyses of the data, provision was not made for the use of enriched maize meal, which means that for mine 10 the mean calcium intake was probably underestimated. Maize meal enriched with calcium and B-vitamins was served at this mine. Unenriched maize meal is a poor source of calcium and, since maize meal porridge forms the bulk of the diet, it can be accepted that the consumption of the enriched maize meal will make a significant contribution

towards the improvement of calcium intake. Further analysis will be undertaken to confirm this. Magnesium intakes were low while phosphorus intakes met the guideline, with the exception of mine 1. Excellent sources of phosphorus are meat, poultry, fish and eggs, while milk, cereal, legumes and grains are good sources of phosphorus. Maize meal porridge, stiff cooked, provides 41 mg phosphorus per 100 g of maize meal (Langenhoven, et al., 1991). Evaluation of the types of food eaten at the mines showed that maize meal porridge was at the top of the list of foods consumed at most of the mines. Potassium intakes were low when compared to the estimated minimum requirements (2 000 mg) for healthy persons (Subcommittee on the Tenth Edition of the RDAs, 1989). Vegetables and fruit are good sources of potassium, and evaluation of the type of food consumed showed that the consumption of these foods was low. Potassium is important for the transmission of nerve impulses, the control of skeletal muscle contractility, and for the control of blood pressure (Subcommittee on the Tenth Edition of the RDAs, 1989).

The intake of zinc was, with the exception of mines 1,7 and 8, in agreement with the DRI. Since there is incomplete information on the selenium content of food in the food composition database used for the analyses the data, selenium intakes are not reported on.

Table 4.5.2.1: Mineral intakes of mineworkers at different mines

Mines[a]		1	2	3	4	5	6	7	8	9	10	DRI[b]
	N	49	50	22	22	50	49	50	103	48	50	
Calcium (mg)												
	Mean	218	207	463	294	260	407	282	354	529	336.0	1000
	Std	258	177	359	312	318	405	295	366	496	367	
	Median	134	175	366	213	146	266	180	216	340	197	
	Min	0.1	10	73	40	0	82	13	0	50	16	
	Max	1 134	1 013	1 151	1 347	1 480	2 240	1 617	1 737	2 310	1 964	
Iron (mg)												
	Mean	5.3	8.1	12.0	10.4	8.4	9.9	7.3	7.3	10.3	8.0	8
	Std	3.4	5.8	6.0	6.5	6.3	4.5	5.7	5.2	6.3	3.6	
	Median	4.2	6.5	11.0	9.1	7.4	8.9	5.82	6.15	8.35	7.74	
	Min	0.0	1.4	4.0	1.6	1.3	2.4	1.89	0.24	1.39	1.66	
	Max	15.1	32.9	24.8	29.8	35.6	22.5	32.3	28.84	26.1	19.93	
Magnesium (mg)												
	Mean	182	325	434	401	274	313	248	246	334	290	**420**
	Std	142	150	227	184	156	151	115	159	157	134	
	Median	150	286	322	370	228	295	231	229	323	272	
	Min	5	80	176	94	37	103	70	24	55	44	
	Max	855	916	856	801	941	925	600	933	858	835	
Phosphorus (mg)												
	Mean	692.15	1101	1 442	1 284	900	1 224	882	905.56	1 311	976.45	**700**
	Std	479.23	601	769	580	536	563	491	610.41	708	495.08	
	Median	533.56	1025	1 140	1 173	810	1 137	804	779.23	1 125	832.63	
	Min	1.74	191	563	334	143	216	304	57.6	163	169.2	
	Max	2 633.51	3 321	3 283	2 314	2 856	3 017	2 726	3 289.89	3 728	2 959.5	
Potassium (mg)												**No value**
	Mean	1 051.71	1 979	2 577	2 382	1 508	2 082	1 605	1 492.85	2 286	1 682.37	
	Std	630.34	1 032	1 235	984	916	850	914	975.9	1 038	933.37	
	Median	818.71	1 716	2 094	2 709	1 239	2 012	1 352	1 255.7	1 987	1 460.91	
	Min	55.75	366	1 154	656	301	678	557	84	423	317.7	
	Max	55.74	6 676	5 703	4 065	5 536	4 517	5 704	5 090.45	4 372	4 756.5	
Zinc (mg)												
	Mean	7.10	12.26	15.65	11.10	10.44	13.45	8.76	8.52	15.23	11.08	**11**
	Std	6.13	11.39	11.34	5.68	10.33	8.06	6.66	7.87	10.90	7.73	
	Median	4.83	9.26	12.10	11.17	7.54	12.35	6.55	6.90	11.88	10.01	
	Min	0.03	1.46	3.49	2.28	1.39	1.76	2.29	0.31	1.39	2.86	
	Max	33.18	70.11	51.76	20.47	64.34	41.34	39.21	56.65	55.01	45.84	

[a] Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

[b] Dietary Reference Intakes

4.5.2.2 Vitamins

The mean intakes of the vitamins are given in Table 4.5.2.2. Most of the means were below the DRI. Although underreporting can play a role in the reported low intakes of vitamins, a diet lacking variety can also play a role. The number of food codes used for the coding of dietary intake can be used as an indication of the variety of food consumed by the study population. The number of food codes used for the coding of dietary data at the different mines varied between 36 and 93. In contrast, in a study done on South Africans following a Western type of diet, 669 different food codes were used for coding the dietary data (unpublished data, P Wolmarans). If there is more variety in the diet it is easier to meet micronutrient requirements.

In Figure 4.5.2.2a, the mean and SD for vitamin A intake at each mine are given. This figure shows that the intake of vitamin A was inadequate. Vitamin A helps to protect the body against infection and prolonged deficiency can lead to *inter alia* night blindness and changes of the skin. The mucous membranes of the respiratory, gastrointestinal and genitourinary tracts can also be affected in severe deficiency states. (Mahan, et al., 1992)

The mean intakes of vitamin C were inadequate at all the mines (see Figure 4.5.2.2b) and below the DRI of 90 mg per day. An evaluation of the types of food consumed at the mines showed a very low intake of fruit and fruit juice and this may explain the inadequate intakes of vitamin C. To prevent scurvy, a minimum intake of 10 mg of vitamin C per day is required (Subcommittee on the Tenth Edition of the RDAs, 1989). The mean intake of vitamin C was alarmingly low in the Coal Mine and the variation was also not large in this group of mineworkers. Evaluation of the type of food consumed at this mine showed that vitamin C rich fruit did not feature in the diet. In the interpretation of the data, the limitations of the method used should be taken into account. The 24 hour recall intake may not be a reflection of the habitual dietary intake of the study population, but of the diet consumed on the days on which the dietary data were collected.

Vitamin C is important in several metabolic functions in the body and is an important antioxidant. Vitamin C is also important in promoting resistance to infection and enhances immunity (Balch, et al., 2000). Requirement for vitamin C is increased during emotional or environmental stress and elevated environmental temperatures

(Mahan, et al., 1992). This indicates that the vitamin C requirements of mineworkers may be even higher than the DRI.

Table 4.5.2.2 Mean vitamin intakes of mineworkers at different mines

		Mines[a]										
		1	2	3	4	5	6	7	8	9	10	DRI[b]
	N	50	50	22	22	49	49	50	103	48	50	
Thiamine (mg)												
	Mean	0.61	1.23	1.75	1.42	0.96	1.06	0.97	0.94	1.18	0.98	**1.2**
	Std	0.37	0.76	0.90	0.66	0.60	0.54	0.88	0.68	0.68	0.43	
	Median	0.57	1.16	1.48	1.27	0.86	0.96	0.83	0.83	0.93	0.94	
	Min	0.0	0.15	0.50	0.41	0.12	0.21	0.27	0.07	0.14	0.18	
	Max	1.39	4.65	3.98	2.94	3.32	2.76	6.59		3.65		
Riboflavin (mg)												
	Mean	0.62	1.02	1.63	1.12	0.92	1.10	0.84	0.79	1.20	0.87	**1.3**
	Std	0.5	1.05	1.61	1.05	1.99	0.66	0.85	0.91	0.71	0.65	
	Median	0.42	0.74	1.08	0.79	0.50	0.93	0.62	0.53	1.05	0.65	
	Min	0.02	0.14	0.24	0.19	0.06	0.14	0.05	0.02	0.12	0.19	
	Max	2.2	6.80	7.98	4.67	14.23	3.21	5.23	7.5	2.83	2.74	
Niacin (mg)												
	Mean	9.25	14.9	20.3	13.7	11.8	18.5	11.5	10.32	16.4	12.2	**16**
	Std	8.19	8.6	15.7	9.0	8.9	13.1	8.9	7.74	11.1	9.4	
	Median	6.96	13.6	15.1	11.8	10.1	14.4	10.2	8.6	12.4	10.2	
	Min	0.0	2.4	3.2	1.4	1.1	3.2	1.9	0.24	1.8	1.2	
	Max	40.1	44.5	75.2	37.5	54.1	54.0	51.6	36.65	45.0	58.5	
Vitamin B6 (mg)												
	Mean	0.55	0.97	1.28	0.84	0.85	0.91	0.78	0.75	1.14	0.87	**1.7**
	Std	0.52	0.85	0.81	0.49	0.73	0.48	0.71	0.7	0.76	0.6	
	Median	0.39	0.65	1.11	0.84	0.71	0.84	0.56	0.58	1.04	0.73	
	Min	0.0	0.11	0.28	0.17	0.06	0.19	0.14	0.02	0.12	0.16	
	Max	2.33	4.77	2.92	1.73	4.16	2.66	4.45	4.22	3.45	3.52	
Folate (?g)												
	Mean	111	151	265	326	181	190	181	171	200	187	**400**
	Std	106	94	164	359	114	125	172	178	148	117	
	Median	88	122	225	184	164	165	124	116	146	164	
	Min	7	17	79	29	8	43	15	5	22	10	
	Max	515	399	732	1392	448	741	1 076	1 147	703	552	
Pantho. Acid (mg)												
	Mean	2.3	4.27	4.85	4.51	2.42	3.79	3.01	2.79	3.87	3.03	**5**
	Std	1.73	3.11	2.79	2.81	1.82	1.59	2.19	2.5	1.77	2.3	
	Median	1.79	3.50	4.23	3.59	1.84	3.67	2.32	2.25	3.95	2.11	
	Min	0.0	0.39	1.56	1.08	0.40	0.39	0.66	0.14	0.28	0.37	
	Max	9.66	14.84	12.21	12.35	8.59	7.58	10.33	13.93	7.85	11.1	
Vitamin B12 (?g)												
	Mean	4.3	5.8	10.9	9.8	6.5	10.4	8.0	4.52	6.8	2.8	**2.4**
	Std	11.89	20.1	29.8	24.6	25.2	17.2	28.8	12.97	13.9	2.92	
	Median	0.73	1.1	4.2	1.3	0.8	4.1	1.6	1.44	3.6	2.12	
	Min	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0	0.0	0	
	Max	58.62	136.9	142.6	104.4	175.2	90.8	189.6	110.82	94.9	15.3	

Table 4.5.2.2 (continued) Mean vitamin intakes of mineworkers at different mines

		Mines[a]										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**DRI[b]**
N		49	50	22	22	50	49	50	103	48	50	
Biotin (?g)												
	Mean	17.17	27.8	43.3	58.5	24.2	27.4	31.3	22.71	29.6	24.63	**30**
	Std	15.27	18.6	18.7	89.7	42.3	14.7	47.7	30.89	15.6	18.8	
	Median	12.67	24.5	37.7	31.6	13.4	25.5	19.0	15.02	27.5	17.74	
	Min	0.0	3.5	11.5	2.7	0.8	1.2	4.4	1.2	2.8	2.59	
	Max	90.35	99.9	93.0	336.9	292.9	62.9	328.7	265.77	69.3	83.28	
Vitamin D (?g)												
	Mean	2.63	1.76	2.81	4.16	2.40	6.78	3.18	2.86	3.56	3.79	**10**
	Std	5.29	2.91	3.08	8.42	5.17	8.56	5.30	5.49	6.43	6.67	
	Median	0.63	0.70	1.81	0.66	0.72	2.72	1.23	0.72	1.68	1.11	
	Min	0.0	0.00	0.01	0.00	0.00	0.01	0.00	0	0.00	0	
	Max	35.43	17.83	10.16	35.01	32.66	34.00	30.00	30.67	35.62	35.27	

[a] Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

[b] Dietary Reference Intakes

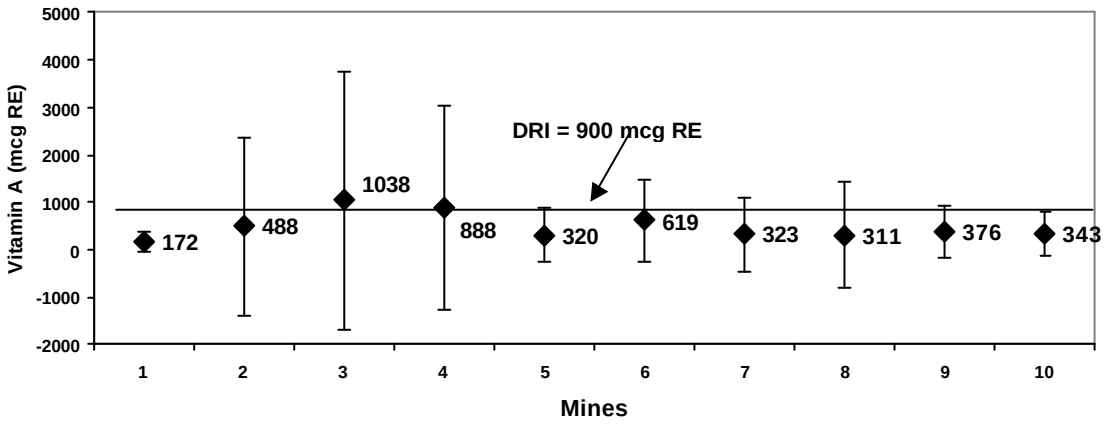


Figure 4.5.2.2a Mean (±sd) vitamin A (mcg RE) intakes compared to the Dietary Reference Intakes (DRI) (mineworkers, n = 493)

Mines: 1 = Coal; 2 = Diamond; 3 = Quarry; 4 = Quarry; 5 = Gold; 6 = Manganese; 7 = Coal; 8 = Platinum; 9 = Iron; 10 = Gold

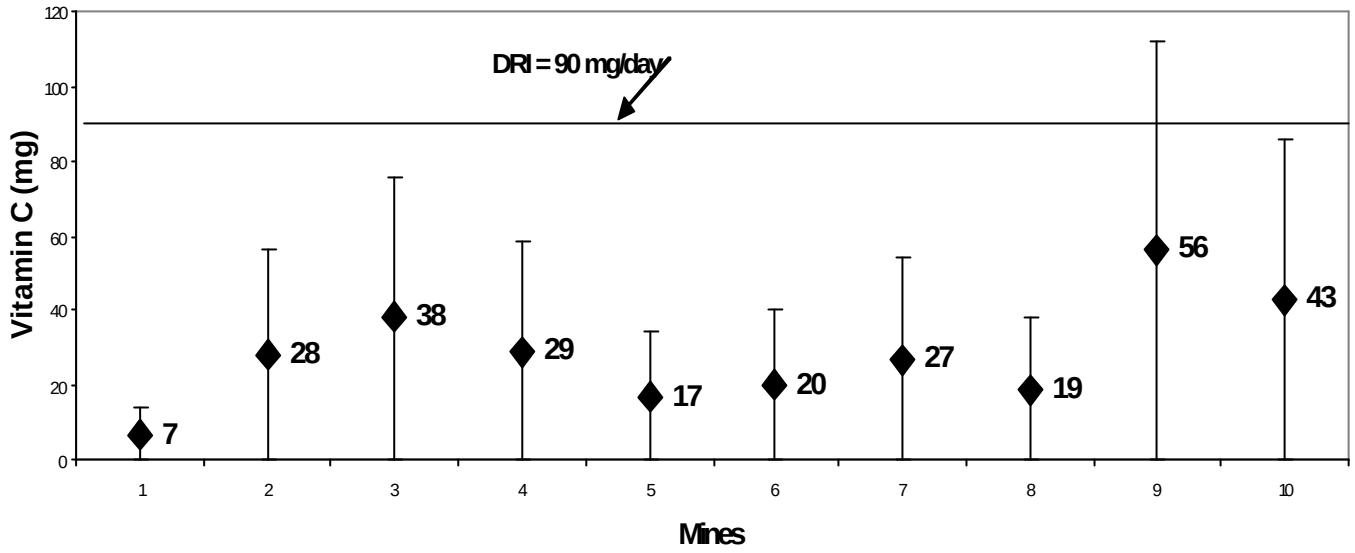


Figure 4.5.2.2b Mean (±sd) vitamin C intakes compared to the Dietary Reference Intakes (DRI) (mineworkers, n = 493)

4.5.2.3 Conclusions on micronutrient intakes

Micronutrient intakes were in general low, and of special concern were the very low intakes of vitamins A and C. Both of these vitamins play an important role in the resistance to infection, while vitamin A is important for seeing in the dark. The latter may be especially important for mineworkers.

4.5.2.4 Recommendation

Special attention should be given to the low intakes of vitamins and minerals. In the analyses of the 24-hour dietary data, the possible consumption of vitamin supplements was not taken into account and this could be explored further in future studies. The consumption of more vitamin C-rich fruit and vegetables should be encouraged and if necessary a vitamin C enriched drink could be offered to the mineworkers. The inclusion of ß-carotene rich vegetables and fruit could help to solve the problem of the very low intake of vitamin A. In those who follow a very low fat diet, the fat intake should be increased to moderate levels to improve the absorption of the fat-soluble vitamins.

4.5.3. Nutritional consumption of hostel dwellers and non-hostel dwellers

In Table 4.5.3.1, the energy and macronutrient intakes of mineworkers living outside the hostels are compared with those living in the hostels. Results show that mean energy, total fat, monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), dietary cholesterol and total carbohydrate intakes were significantly higher in the mineworkers living outside the hostels. The difference in mean energy intake was 924 kJ (221 kcal). If the differences are translated into food intake, the difference in energy intake is equal to the amount of energy provided by about 250 g or 1 cup of maize meal porridge, stiff cooked, or a 65 g portion of fatty beef. The difference in fat intake is equal to 11 g (about two teaspoons) of margarine or a 40 g portion of fatty beef. The question arises as to whether the significant differences in energy and fat intakes are of practical importance.

Table 4.5.3.1: Mean (±sd) energy and nutrient intakes of mineworkers living outside or in the hostels

Nutrient		Outside hostels	In hostels	p-value[a]
N		**280[b]**	**214**	
Energy (kJ)	Mean	7 963	7039	0.0080
	SD	4 083	3 866	
Protein (g)	Mean	78.1	69.6	0.0979
	SD	51.5	44.8	
Fat (g)	Mean	52.1	42.8	0.0028
	SD	39.8	34.0	
SFA (g)[c]	Mean	15.7	14.2	0.1891
	SD	13.8	12.7	
MUFA (g)[d]	Mean	18.4	15.1	0.0073
	SD	15.6	13.1	
PUFA (g)[e]	Mean	13.1	9.2	<0.0001
	SD	11.3	8.8	
Cholesterol (mg)	Mean	275	219	0.0074
	SD	395	290	
Tot carbohydrate (g)	Mean	257.5	229.2	0.0181
	SD	134.1	122.7	
Fibre (g)	Mean	15.8	15.1	0.7579
	SD	10.4	9.9	

[a] $p<0.05$,significantly different; [b] Sample includes one individual who had only water on the day that the dietary data were collected.

[c] SFA = Saturated fatty acids; [d] MUFA = Monounsaturated fatty acids; [e] PUFA = Polyunsaturated fatty acids

Comparison of macronutrient intakes showed that in the diets of mineworkers who lived outside the hostels, a higher percentage of energy came from total fat, MUFA and PUFA than in the diets of mineworkers living in the hostels. (See Table 4.5.3.2) The P/S ratio of the diet of mineworkers who lived outside the hostels was also significantly higher, which indicated that foods richer in polyunsaturated fatty acids were consumed.

Table 4.5.3.2: Mean (SD) macronutrient intakes expressed as a percentage of total energy of mineworkers living outside or in the hostels

Nutrient		Outside hostels	In hostels	p-value[a]
N		280[b]	214	
Protein (%E)	Mean	16.5	17.0	0.4258
	SD	5.6	5.9	
Fat (%E)	Mean	23.2	21.0	0.0192
	SD	10.1	10.1	
SFA (%E)[c]	Mean	6.9	6.9	0.8673
	SD	3.8	4.0	
MUFA (%E)[d]	Mean	8.2	7.3	0.0370
	SD	4.3	4.1	
PUFA (%E)[e]	Mean	5.9	4.6	<0.0001
	SD	3.9	3.7	
Tot carbohydrate (%E)	Mean	56.1	57.0	0.4126
	SD	12.1	12.7	
Alcohol (%E)	Mean	0.7	1.1	0.8326
	SD	4.5	5.4	
P/S ratio	Mean	1.08	0.91	0.0024
	SD	0.78	0.79	

[a] p<0.05,significantly different

[b] Sample includes one individual who had only water on the day that the dietary data were collected.

[c] SFA = Saturated fatty acids [d] MUFA = Monounsaturated fatty acids [e] PUFA = Polyunsaturated fatty acids

Although the percentage of energy from alcohol was higher in the diets of those who stayed in the hostels than in those living outside the hostels, the difference was not statistically significant. Data collected by the questionnaire (see Section 4.4.1) also

showed that hostel dwellers consumed more beer than non-hostel dwellers, while non-hostel dwellers consumed more spirits than hostel dwellers. Mineral intakes of mineworkers living outside the hostels did not differ significantly from those living in the hostels, with the exception of potassium. (See Table 4.5.3.3) This could reflect a difference in fruit intake between the groups since Table 4.5.3.4 also shows that vitamin C intakes were significantly lower in hostel dwellers. Citrus fruit is not only a good source of vitamin C but also of potassium. Important dietary sources of potassium are fruit, vegetables and fresh meat.

Table 4.5.3.3: Mean (SD) mineral intakes of mineworkers living outside or in the hostels

Nutrients		Outside hostels	In hostels	P-value[a]
N		280[b]	214	
Calcium (mg)	**Mean**	316	350	0.7203
	SD	313	407	
Iron (mg)	**Mean**	8.59	7.81	0.3974
	SD	5.81	5.04	
Magnesium (mg)	**Mean**	294	273	0.1085
	SD	163	165	
Phosphorus (mg)	**Mean**	1 044	985	0.2129
	SD	610	613	
Potassium (mg)	**Mean**	1 860	1 607	0.0010
	SD	1 032	992	
Zinc (mg)	**Mean**	10.94	10.6	0.7978
	SD	9.02	9.1	

[a] $p<0.05$,significantly different

[b] Sample includes one individual who had only water on the day that the dietary data were collected.

Mean vitamin A, thiamine, pantothenic acid, biotin and vitamin C intakes were significantly higher in the diet of mineworkers who lived outside the hostels compared to those living in the hostels. (See Table 4.5.3.4) The low intakes of vitamins A and C in both groups are of concern. Intakes of vitamin supplements, if any, were not taken into account as part of the 24-hour dietary recall analyses.

Table 4.6.3.4: Mean (SD) vitamin intakes of mineworkers living outside or in the hostels

Nutrients		Outside hostels	In hostels	p-value[a]
		280[b]	214	
Vitamin A (µg RE)	**Mean**	507	294	0.0070
	SD	1492	491	
Thiamine (mg)	**Mean**	1.11	0.95	0.0094
	SD	0.75	0.61	
Riboflavin (mg)	**Mean**	0.99	0.89	0.0524
	SD	1	1013	
Niacin (mg)	**Mean**	13.8	12.19	0.1030
	SD	10.72	9.14	
Vitamin B6 (mg)	**Mean**	0.87	0.84	0.7642
	SD	0.7	0.69	
Folate (µg)	**Mean**	191	171	0.7835
	SD	186	124	
Vitamin B12 (µg)	**Mean**	7.66	4.53	0.6603
	SD	21.7	13.71	
Pantothenic acid (mg)	**Mean**	3.61	2.82	<0.0001
	SD	2.56	2.06	
Biotin (µg)	**Mean**	31.06	22.77	<0.0001
	SD	39.27	25.34	
Vitamin C (mg)	**Mean**	35	16	<0.0001
	SD	77	36	
Vitamin D (µg)	**Mean**	3.6	2.94	0.2208
	SD	6.29	5.56	

[a] $p<0.05$,significantly different

[b] Sample includes one individual who had only water on the day that the dietary data were collected.

There are indications that the dietary intakes of mineworkers living outside the hostels were more favourable than those living in the hostels. Analyses of the 24-hour dietary recall data showed that mineworkers who lived outside the hostels had significantly higher energy, total fat, dietary cholesterol and total carbohydrate intakes. Vitamin A and vitamin C intakes were also significantly higher in those living outside than in those living in the hostels, although in both groups mean intakes were low. While the difference in mean energy intake seems small, the differences in micronutrient intakes, especially vitamin A and vitamin C, are of concern and need attention. The low intakes

of vitamins A and C are probably the result of inadequate intakes of vegetables and fruit by both groups, and the mineworkers should be encouraged to eat more vegetables and fruit.

4.6 Anthropometric measurements

KEY FINDINGS (SECTION 4.6)

- The mean height for hostel dwellers and non-hostel dwellers was exactly the same, i.e. 1.67 m
- The mean weight for hostel dwellers and non-hostel dwellers was 70.7kg and 72.5kg respectively (p=0.14).
- The mean BMI values for the study groups fall into the 'normal weight'.
- At the Diamond Mine, 19% of the workers interviewed were obese, and 33% were overweight, 25% of these mineworkers were hypertensive and 6% had diabetes
- At the Platinum Mine, 45% of the study participants were overweight, 22% were obese, and 3% were underweight, 7% were hypertensive and 3% had diabetes.
- At the gold mines 0.75% of the study participants were underweight, 48% were overweight and 7% were obese (10% had hypertension and no diabetics).
- At the coal mines, 4% of the study participants were underweight, 39% were overweight and 14% were obese (17% had hypertension and 4% had diabetes).
- At the quarries, 2,5% of the study participants were underweight, 25% were overweight, and 18,5% were obese, 36% of these participants were hypertensive and 9% had diabetes.
- At the base mineral mines (Iron and Manganese), 4,25% of the study participants were underweight, 35% were overweight and 15% were obese; 19% had hypertension and 1% had diabetes
- There is a significant difference between the number of underweight, overweight and obese mineworkers (Table 4.6.1) in the hostels compared to those not staying in the hostels (p=0.031).
- Fifty four percent of non-hostel dwellers are overweight or obese compared to 45.6% of hostel dwellers and 5% of non-hostel dwellers were underweight compared to 2% of hostel dwellers

The distribution of height and weight of mineworkers at the different mines is demonstrated by the box and whisker plot in Figure 4.6.1. The mean height for hostel dwellers and non-hostel dwellers was exactly the same, i.e. 1.67m. The mean weight of hostel dwellers and non-hostel dwellers was 70.7kg and 72.5kg respectively (p=0.14).

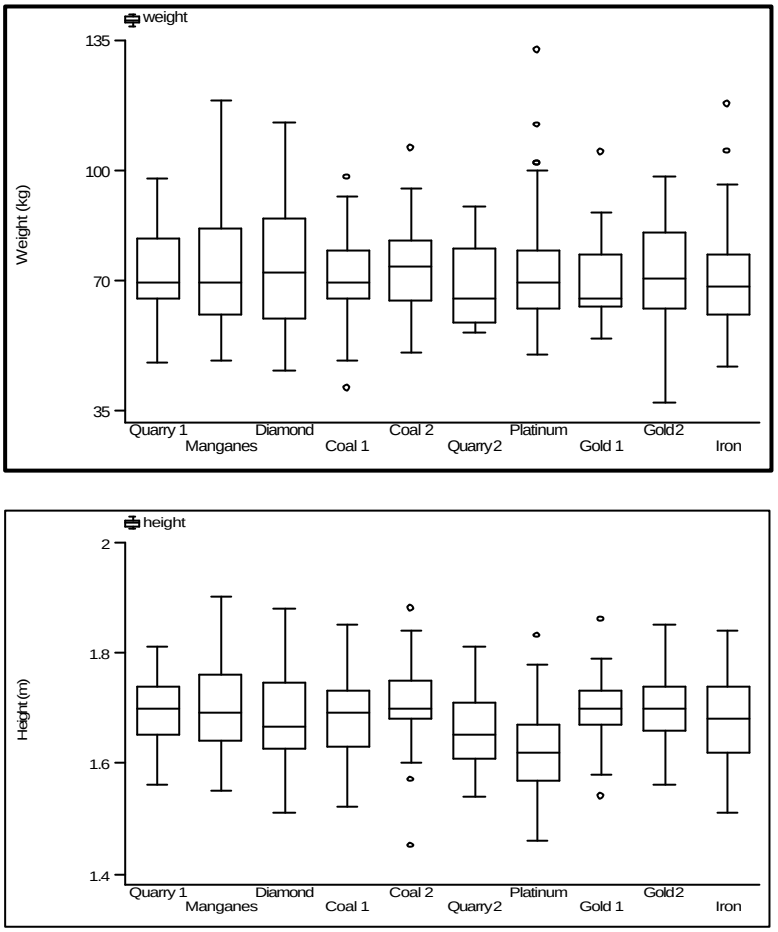


Figure 4.6.1: Height and weight of mineworkers at the different mines

The Body Mass Index (BMI) values provide an indication of whether an individual's body mass is 'normal' or not. The BMI values recorded in the sample of mines are given in Figure 4.6.2. BMI is a ratio (i.e. weight/(height)^2).

An individual with a BMI of less than 18,5 is considered underweight; an individual with a BMI between 18,6 and 24,9 is considered normal; a BMI of between 25 and 29,5 is considered overweight, and a BMI of greater than 30 is obese.

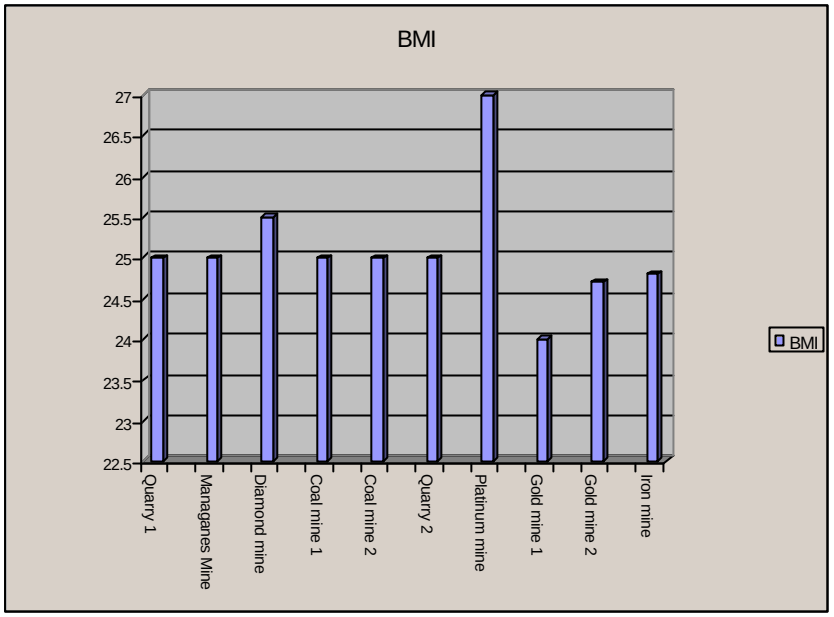


Figure 4.6.2: Average BMI for the whole group of mineworkers interviewed at each mine

Figure 4.6.2.suggests that the mean BMI values for the study groups fall into the 'normal weight' category, the exceptions being the Diamond Mine and the Platinum Mine groups, which are considered to be overweight. The average BMI values for hostel dwellers and non-hostel dwellers are very similar, 25.1 and 25.6, respectively. The box and whisker plot in Figure 4.6.3 confirms that just over half of the non-hostel dwellers and hostel dwellers fall into the overweight category.

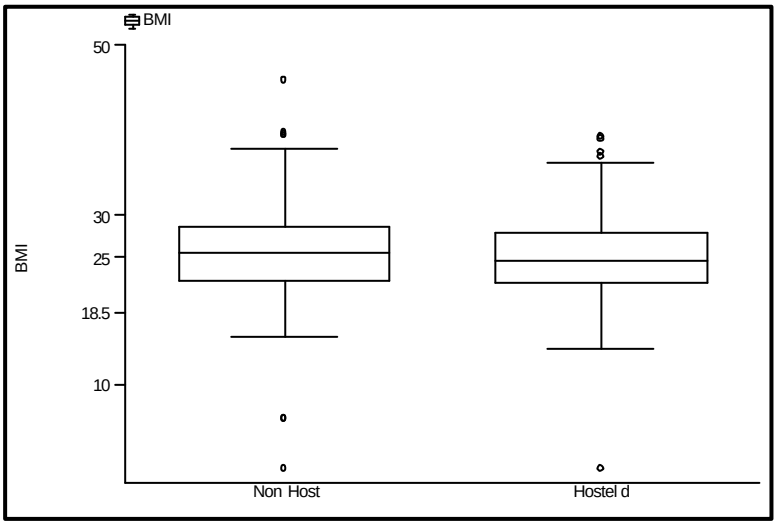


Figure 4.6.3: BMI of hostel and non-hostel workers

At the Diamond Mine, 19% of the workers interviewed were obese, and 33% were overweight. The average age of the group of diamond mineworkers interviewed was 47 years and 25% of these mineworkers were hypertensive and 6% had diabetes. At the Platinum Mine, 45% of the study participants were overweight, 22% were obese, and 3% were underweight. Of the platinum mineworkers interviewed, 7% were hypertensive and 3% had diabetes. At the gold mines (combined) 0.75% of the study participants were underweight, 48% were overweight and 7% were obese (10% had hypertension and no diabetics). At the coal mines, 4% of the study participants were underweight, 39% were overweight and 14% were obese (17% had hypertension and 4% had diabetes). At the quarries, 2,5% of the study participants were underweight, 25% were overweight, and 18,5% were obese. The mean age of the study participants at the quarries was 42, and 36% of these participants were hypertensive and 9% had diabetes. At the base mineral mines (Iron and Manganese), 4,25% of the study participants were underweight, 35% were overweight and 15% were obese; 19% had hypertension and 1% had diabetes.

At Gold mine 1, mineworkers with hypertension or diabetes were provided with ingredients to prepare their food. At the platinum mine, mineworkers with hypertension/diabetes were advised on what to eat and at Gold mine 2 snacks were provided to diabetic mineworkers.

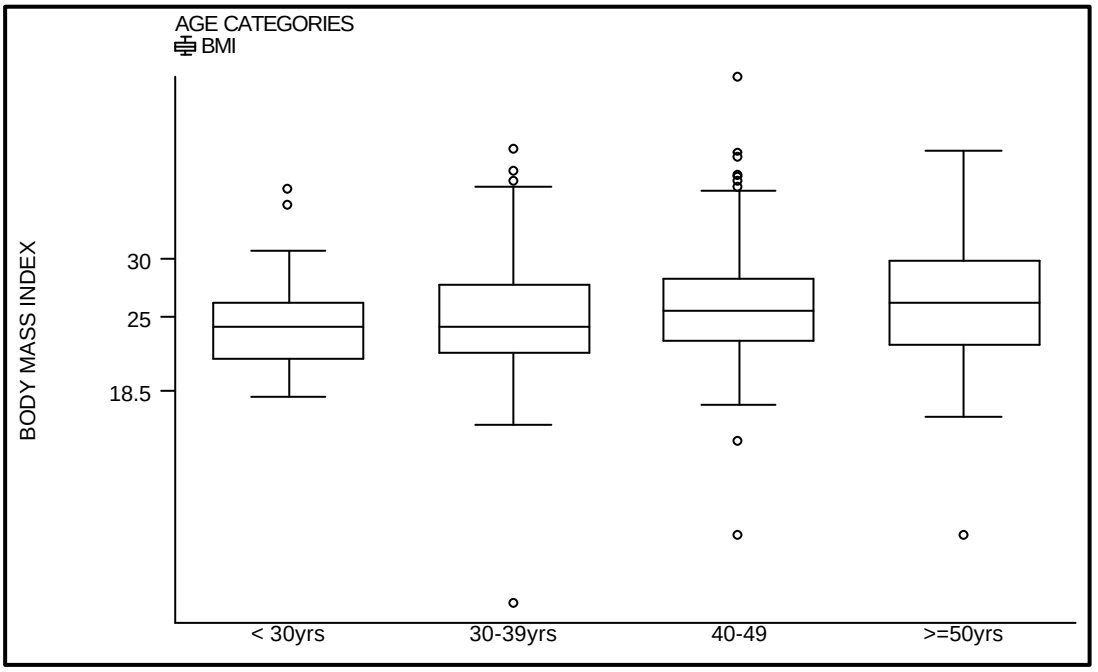


Figure 4.6.4: Range of BMI for the different age categories

Figure 4.6.4 demonstrates the different BMI of the different age categories for all the study participants. The mean BMI increases significantly with age (p=0.009). For those younger than 30 years, the mean BMI was 24.3; for the 30 to 39 year age group it was 24.8; for the 40 to 49 year age group it was 25.8, and for the over 50 age group it was 26.3. This is a normal finding, which is often seen in other studies. This is usually because of decrease in metabolic rate and decreased physical activity, as one gets older.

Table 4.6.1: BMI ranges for hostel and non-hostel dwellers

	Underweight	Normal	Overweight	Obese	Total
Non Hostel Dweller	14	114	103	50	281
(%)	4.98	40.57	36.65	17.79	100
Hostel dweller	4	108	67	27	206
(%)	1.94	52.43	32.52	13.11	100
Total	18	222	170	77	487
	3.7	45.59	34.91	15.81	100

Although there is no significant difference between the mean BMI for hostel and non-hostel dwellers (Figure 4.6.3), there is a significant difference between the number of underweight, overweight and obese mineworkers (Table 4.6.1) in the hostels compared to those not staying in the hostels (p=0.031). Fifty four percent of non-hostel dwellers are overweight or obese compared to 45.6% of hostel dwellers and 5% of non-hostel dwellers were underweight compared to 2% of hostel dwellers.

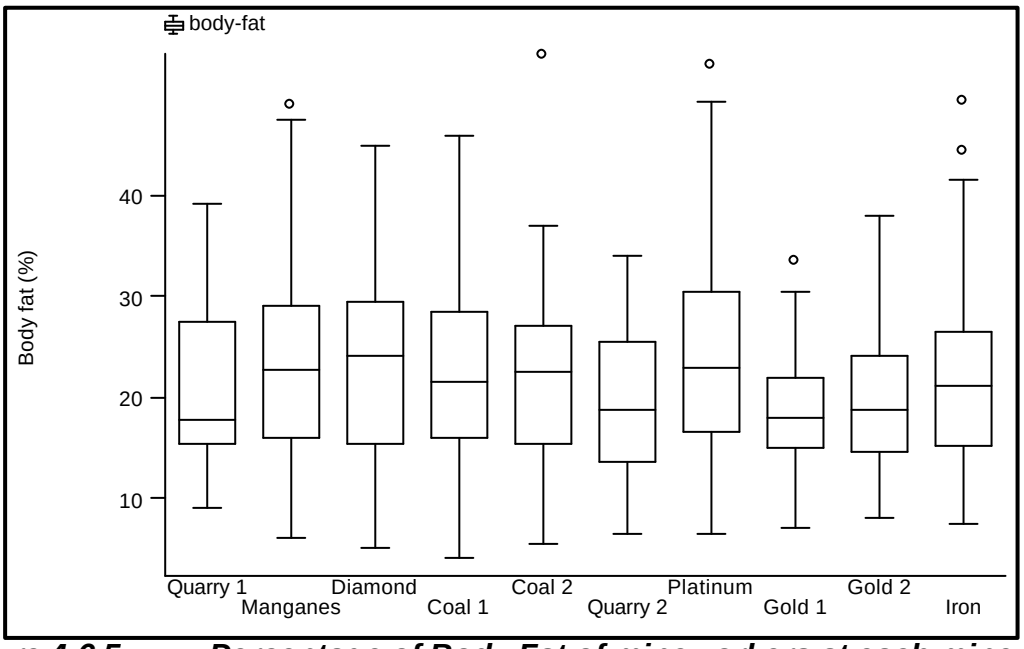


Figure 4.6.5: Percentage of Body Fat of mineworkers at each mine

Figure 4.6.5 shows the distribution of body fat for the study participants at each mine. BMI is said to not be able to differentiate between very fat and muscular people, but Figure 4.6.5 shows a correlation of body fat with BMI, which is linear. This suggests that the study population is probably truly overweight, although there is a small percentage that is possibly muscular.

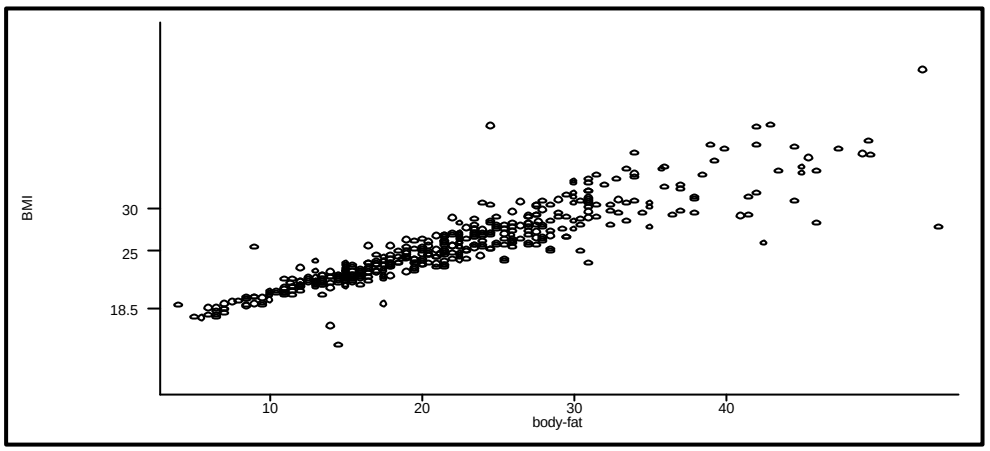


Figure 4.6.6: Correlation of body fat and BMI of study participants

4.7 Work-related injuries and medical conditions

KEY FINDINGS (SECTION 4.7)

- Hostel dwellers drank significantly more fluids during the shift than non-hostel dwellers (p=0,001). Hostel dwellers drank on average 1 120 ml of water compared to 802ml by non-hostel dwellers
- The group of hostel dwellers experienced headaches, faintness or muscle cramps more often than the non-hostel dwellers did.
- Hostel dwellers were 2.2 times more likely to have had TB than non-hostel dwellers (p<0.021) in this nutrition study
- Hostel dwellers were 1.3 times more likely to have received compensation for an injury than non-hostel dwellers; this was not statistically significant (p=0.23).
- Twenty percent of hostel dwellers had received compensation for work-related injuries compared to 16% of non-hostel dwellers.
- Most of the accidents occurred during the first part of the day shift between 8h00 and 13h00
- On the limited data available and inherent limitations, no differences could be determined for injury for hostel and non-hostel dwellers.
- The design of the study did not allow for direct correlation between dietary intake and injury, the fact that such a large percentage of workers did not eat breakfast is of concern.

In an effort to determine if there was any possible association between nutrition and occupational health and safety, questions were included in the questionnaire that related to:

- heat disorders;
- TB;
- injuries; and
- diabetes and hypertension.

Over and above this, when available, information on accidents and TB incidence at the eight mines was collected as requested by MOHAC. The two quarries did not have any accident statistics for the year.

Study participants were asked about headaches, faintness or muscle cramps during the shift. Hostel dwellers drank significantly more fluids during the shift than non-hostel dwellers (p=0,001). Hostel dwellers drank on average 1 120 ml of water compared to 802ml by non-hostel dwellers. However, the group of hostel dwellers experienced these symptoms (i.e. headaches, faintness or muscle cramps) more often than the non-hostel dwellers did. Factors like hypoglycaemia and low potassium due to no/little food intake could play a role in these symptoms since non-hostel dwellers had a higher intake of potassium than hostel dwellers. According to the literature, dietary deficiencies in potassium do not occur under normal circumstances (Subcommittee on the Tenth Edition of the RDAs, 1989).

Diet and the excessive intake of fats in particular, has long been recognised as a risk factor for the development of heart and other degenerative diseases in Western countries (Masironi, 1970) and (Ulbricht, et al., 1991). Although fat intake is, at present, not too high and although it meets the prudent guideline for fat intake, care should be taken to prevent the increase of fat intakes in those already following a diet providing more than 25% E from fat. Hypertension and diabetes were more prevalent among the non-hostel dwellers than the hostel dwellers. The nutritional content of the non-hostel dwellers was higher in fat and cholesterol[6]. There may be a relation but this could not be proven due to the study design.

TB bacilli are spread by inhalation of airborne droplets produced by mineworkers with active pulmonary TB. Increased transmission occurs with overcrowding as seen with hostel dwellers staying in single sex hostels (Churchyard, et al., 2002). Modelling of factors associated with TB incidence now being done for SIMRAC indicates a lower risk for TB among miners in non-hostel single partner or family accommodation (Churchyard, et al., 2002). Therefore, with regard to TB, hostel dwellers were 2.2 times more likely to have had TB than non-hostel dwellers ($p<0.021$) in our study. Diet may also play a role in the difference in the prevalence of TB. The intakes of vitamins C and A were significantly lower in the hostel dwellers than in the non-hostel dwellers. Vitamin C and vitamin A both play an important role in the resistance to infection. Vitamin C also enhances immunity (Balch, et al., 2000). It would be worthwhile investigating the differences in nutritional status between those with TB and those without TB in more detail. TB statistics from Gold Mine 2 for the year 2002 showed that 5% of hostel dwellers and 3.7% of non-hostel dwellers were diagnosed with TB.

[6] This effect does not appear to be related to age. The mean age of hostel dwellers was 42.9 years compared to 38 years for non-hostel dwellers.

Hostel dwellers were 1.3 times more likely to have received compensation for an injury than non-hostel dwellers; this was not statistically significant (p=0.23). Twenty percent of hostel dwellers had received compensation for work related injuries compared to 16% of non-hostel dwellers. Figure 4.7 demonstrates the percentage of accidents for hostel dwellers and non-hostel dwellers for one year at the manganese, platinum, coal and gold mine. Thus on the limited data available and inherent limitations, no differences could be determined for injury for hostel and non-hostel dwellers.

A large percentage of the accidents at the mines occurred early in the week (around Tuesday) and then again just before the weekend. Most of the accidents occurred during the first part of the day shift between 8h00 and 13h00. There are several factors that could be responsible for the occurrence of accidents during a specific day or time of day, for example, there may be a greater number of workers on the day shift than on the night shift; also most maintenance occurs during the day. The design of the study did not allow for direct correlation between dietary intake and injury, the fact that such a large percentage of workers did not eat breakfast is of concern.

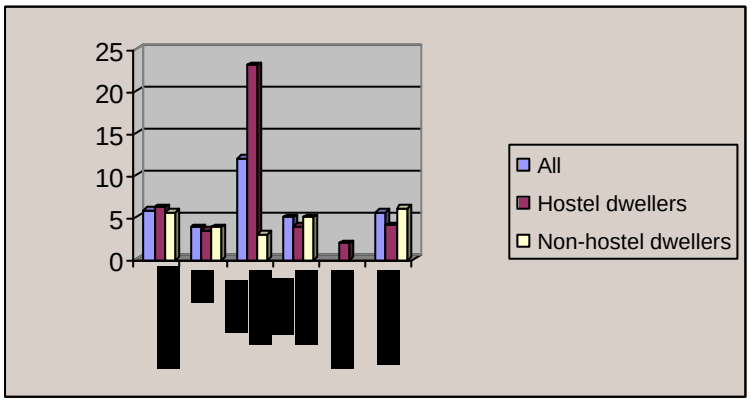


Figure 4.7: Percentage of hostel dwellers and non-hostel dwellers involved in mine accidents

4.8 KAP study of mine management and hostel managers

KEY FINDINGS (SECTION 4.8)

- In a telephone survey of 102 mines:
  - Sixty mines had mass catering canteens, 42 did not.
  - Six percent of permanent staff and 2.5% of contractors were not allowed to take food underground
  - Ninety four mines has special underground eating areas at the mine
  - Seven percent of permanent mineworkers and 11.9% of contractors were working in gold mines where they had no meal break during the underground shift.
  - The mean duration of the meal break for all mines surveyed was 30 minutes
- Of the seven hostel kitchens surveyed, five mines provided the kitchen staff and facilities while two kitchens had been sub-contracted to private companies
- The daily strength at the kitchen varied from 50 to 4 975 mineworkers for breakfast and from 200 to 5 981 for the main meal.
- The cost of meals ranged from R5.00 to R9.63.
- Only one kitchen (at the iron mine) provided food packs for mineworkers to take to work.
- At the platinum mine, fortified mageu was given to the mineworkers at the shaft.
- The survey found that most of the hostel kitchen staff had received little or no training, except at the kitchens where a consulting dietician (at the Platinum Mine and at Gold Mine 2) or full-time food service manager (at Gold Mine 2) were available
- At all 7 hostel kitchens, internal hygiene audits were carried out. At only one mine hostel kitchen was there an external hygiene audit done by the Department of Minerals and Energy.

4.8.1 Telephone survey of mine management

The telephone survey conducted in part 2 of the nutrition and housing and occupational health and safety report (see Section 3.1) asked managers at 102 mines about their canteens and midshift feeding. Sixty mines, had mass catering canteens. This left 42

mines that did not, The majority of these were in the North-West province, where 12.6% of all single-sex hostel dwellers and 22.7% of all workers with rent subsidies worked at five mines which do not have a canteen.

The vast majority of both permanent and contract workers are permitted to take food underground on their shift, leaving only 6% of permanent workers and 2.3% of contractors who are not. The most significant prohibition applies to about 11 500 workers at two platinum mines, in contrast with nine other platinum mines employing 76 741 workers who are not prohibited from taking food underground. In some mines, liquid food supplement is given to a total of around 5 000 mineworkers, although they are not permitted to take solid food underground. The main reason for the prohibition where it is enforced is "hygiene. Respondents reported that 80.9% of all permanent workers and about 70% of contractors at 84 mines were provided with food by the mine to take underground, but this may refer to liquid food supplement only.

Ninety-four mines responded as to whether they had special underground eating areas at the mine. Sixty-six of them, that employed 63.8 and 80.5% of permanent and contract workers respectively, responded that they had such areas, leaving 28 mines employing about one third of permanent workers that did not. The vast majority of the latter employees were in gold and platinum mines in the Free State and North-West province.

Although 92.7% of all permanent workers at 95 mines that responded reported they had underground mid-shift meal breaks as required by law, 7.1% of permanent mineworkers, and 11.9% of contractors in 95 of the survey mines were working in gold mines (mainly in the Free State and Gauteng) where they had no meal break during the underground shift. The mean duration of the meal break for all mines in the survey was 30 minutes, which applies across the board in the industry, and suggests that the industry as a whole receives a special dispensation from the Department of Labour to reduce the statutory meal break from one hour to 30 minutes on application, in terms of the Basic Conditions of Employment Act 1997, which requires an agreement in writing.

4.8.2 Hostel kitchen visits

Table 4.8.2 is a summary of all the interviews of hostel managers conducted at the mines where there was a hostel kitchen. Please refer to the appendices at the end of this report for more details, such as the menu at each kitchen.

Of the seven hostel kitchens surveyed, five mines provided the kitchen staff and facilities while two kitchens had been sub-contracted to private companies. The daily strength at the kitchen varied from 50 to 4 975 mineworkers for breakfast and from 200 to 5 981 for the main meal. Only one of the hostel kitchens provided a third meal; the rest provided breakfast and a main meal. The cost of meals ranged from R5.00 to R9.63. Only one kitchen (at the iron mine) provided food packs for mineworkers to take to work. At the platinum mine, fortified mageu was given to the mineworkers at the shaft. At the gold mines, food was provided and prepared for diabetic mineworkers, and at the Platinum Mine, advice about nutrition was given to diabetic mineworkers.

All kitchens ran 24 hours a day and were open to the mineworkers in the morning, most of the afternoon and into the late evening, seven days a week, including public holidays. Most kitchens made use of a system where mineworkers presented their ID cards to gain access to the kitchen or/and to obtain a protein serving. Five of the hostel kitchens provided food only for hostel dwellers, whereas at the other kitchens all mine employees had access to the food produced by the kitchen. The survey found that most of the hostel kitchen staff had received little or no training, except at the kitchens where a consulting dietician (at the Platinum Mine and at Gold Mine 2) or full-time food service manager (at Gold Mine 2) were available. Most of the hostel kitchens followed a ration scale, especially for meat.

Only three hostel kitchens had a kitchen policy, which defined and documented its policy, objectives and commitment concerning hygiene. It included establishing, documenting, and maintaining procedures for the hygienic handling, storage, packaging and delivery of food products. Internal hygiene audits were carried out at all seven hostel kitchens. At only one mine hostel kitchen was there an external hygiene audit done by the Department of Minerals and Energy. Code of Practice for Food Hygiene management is available from the Council of the South African Bureau of Standards (SABS 049-1989)

Table 4.8.2: ***Summary of* in situ *interviews at the mine hostel kitchens***

	Manganese Mine	Iron Mine	Plat-kitchen 1	Plat-kitchen 2	Coal Mine 1	Gold Mine 1	Gold Mine 2
GENERAL							
Who was interviewed?	Hostel manager	Kitchen manager and kitchen administrator	Hostel manager	Hostel manager	Kitchen manager	Hostel manager and catering superintendent	Hostel kitchen supervisor
Who provides the staff and facilities?	The mine	Sub-contracted	The mine	The mine	Sub-contracted	The mine	The mine
Potential no. of mineworkers entitled to eat at the kitchen	430	4 800	992 Without contractor	1 575 Without contractor	1 509	7 000	4 000
Who has access to kitchen?	Hostel dwellers	All mine employees and family	Hostel dwellers	Hostel dwellers	All mine employees that are logged on to the kitchen computer system	Hostel dwellers	Hostel dwellers
No. of meals	2	2	2	2	2	2	3
No. of mineworkers eating breakfast	330	50-60	750		224	4 975	2 816
No. of mineworkers eating at the main meal	330	200-300	1 041	3 432	702	5 981	3 780
Cost per day for meals served	R8.01	R9.50	R7.45	R7.21	R9.63	R7.00	R5.50
Is there provision for mid-shift feeding?	No	Yes, food packs can be ordered at main meal	One litre of Mageu at shaft	One litre of Mageu at shaft	No	No	No
How do mineworkers access meals?	Swipe ID cards	Buy meal coupons	Swipe ID cards	Swipe ID cards	Swipe their ID cards	Swipe ID card with protein serving	Swipe ID card
Time open for breakfast	4:00 – 7:00	5:00 – 9:00	4:30 – 7:00	3:00 – 7:00	22:00 – 9:00	3:00 – 9:00	
Times open for main meal	3:00-20:30	14:00 – 22:00	11:00 – 18:00	10:00 – 18:00	12:00 – 20:00	11:00 – 24:00	

Table 4.8.2: Summary of *in situ* interviews at the mine hostel kitchens (continue)

	Manganese Mine	Iron Mine	Plat-kitchen 1	Plat–kitchen 2	Coal Mine 1	Gold Mine 1	Gold Mine 2
Other times hostel kitchen open	10:00 – 10:30	11:00 – 13:00					
Open on weekends and public holidays?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
How much wastage is generated?	210 litres per month	8-10 Kg/day	153g/person	87g/person	Meals left over are served at the next meal	6-10 drums per day	205 litres per day
Are diabetics provided for?	No	No	No, but advised on what to eat	No, but advised on what to eat	No	Yes	Snack packs are provided
Is there a feeding committee?	Yes	No, take part in the hostel committee meeting if there are concerns with food	Yes	Yes	Yes	Yes	
Health and safety checks	Yes	Yes	Yes	Yes	Yes	Yes	Yes, very thorough
Kitchen procedure or policy document	Yes	Yes, but at head office in Johannesburg	No	No	No	No	No
KITCHEN STAFF AND FACILITIES							
No. of kitchen staff	21					60	78
Kitchen staff makes use of recipes?	No	No	No	No	No	Yes	No
Kitchen staff receives regular training?	No	No	Yes	Yes	No	Yes	No
Medical surveillance of kitchen staff	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4.8.2: Summary of *in situ* interviews at the mine hostel kitchens (continue)

	Manganese Mine	Iron Mine	Plat-kitchen 1	Plat-kitchen 2	Coal Mine 1	Gold Mine 1	Gold Mine 2
Food preparation	Fair	Good	Good	Good	Fair	Good	Excellent
Food storage	Fair. Labels on frozen food not clear	Fair but refrozen meat not kept in same fridge. No clear labels	Excellent	Excellent	Fair, some rotten vegetables seen in the fridges	Excellent	Excellent
Stock control measures	Good	Excellent	Good	Good	Fair	Good	Excellent
Batch cooking	Yes	Yes	No	Yes	Yes	Yes	Yes
Dining hall facilities	Good.	Fair	Good	Fair	Good	Excellent, with private cubicles	Fair
Eating utensils (i.e. plates and washing up facilities)	Mine worker provides own	Mine worker provides own	Mine provides	Mine worker provides own	Mine worker provides own	Mine or mine worker provides	Mine provides
MENU							
Dietician	Consulted a dietician once	No	Consulting dietician	Consulting dietician	No	Food service manager on permanent basis	Consulting dietician
Who developed the menu?	Not sure	Not sure	Dietician	Dietician	Menu from another mine	Dietician at mine hospital	Previously employed dietician
Do they follow a ration scale?	Yes	Yes, but not given	Yes	Yes, but not given	Yes	Yes	Yes
Ration scale for meat	250 g		180 g		300 g	240 g	235 g
Ration scale for vegetables / fruit	150 g				75 g	100 g	200g for vegetables and 150g for fruit

Table 4.8.2: Summary of *in situ* interviews at the mine hostel kitchens (continue)

PLATE SURVEY: Average portion sizes in grams							
	Manganese Mine	**Iron Mine**	**Plat-kitchen 1**	**Plat–kitchen 2**	**Coal Mine 1**	**Gold Mine 1**	**Gold Mine 2**
Pap	217	912	611	612	634	401	378
Samp	178	976	488	676	529	570	206
Vegetables	125	155	283	218	95	320	147
Chicken	136	168	144	154	188		
Soup / Gravy	193	178	160	128	200	231	188
Juice		200			1 000		
Salad			82			110	
Mealie rice						364	
Meat						285	
Wors (sausage)				130	201		155
Fruit				128		224	

4.8.3 Plate survey conducted at the hostel kitchens

A randomly selected meal was chosen on which to do a plate survey. Conducting a plate survey entailed selecting 10 consenting hostel dwellers to have each portion of their meal weighed (cooked portion) to determine the portion sizes. All meals surveyed were the main meal. Most meals were made up of a portion of pap, samp, meat and a vegetable.

Figure 4.8.3.1 demonstrates the average serving of pap at each mine. The Iron Mine served the biggest portions at an average of 912 g of pap per mineworker, while the Manganese Mine had the smallest portion, i.e. an average of 217 g per mineworker. Both kitchens at the Platinum Mine served similar portion sizes.

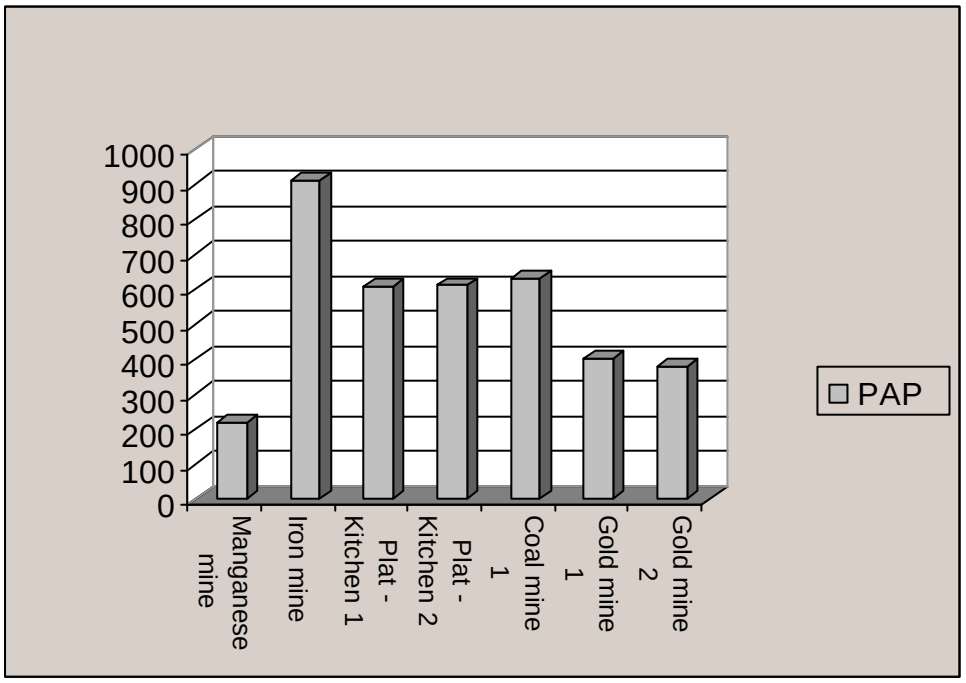


Figure 4.8.3.1: Average portion sizes (in grams) of pap served to hostel dwellers at the different mines

On average, 80% of the plates surveyed had pap. However, at the Iron Mine only 50% had pap, and at Gold Mine 1, 40% had pap.

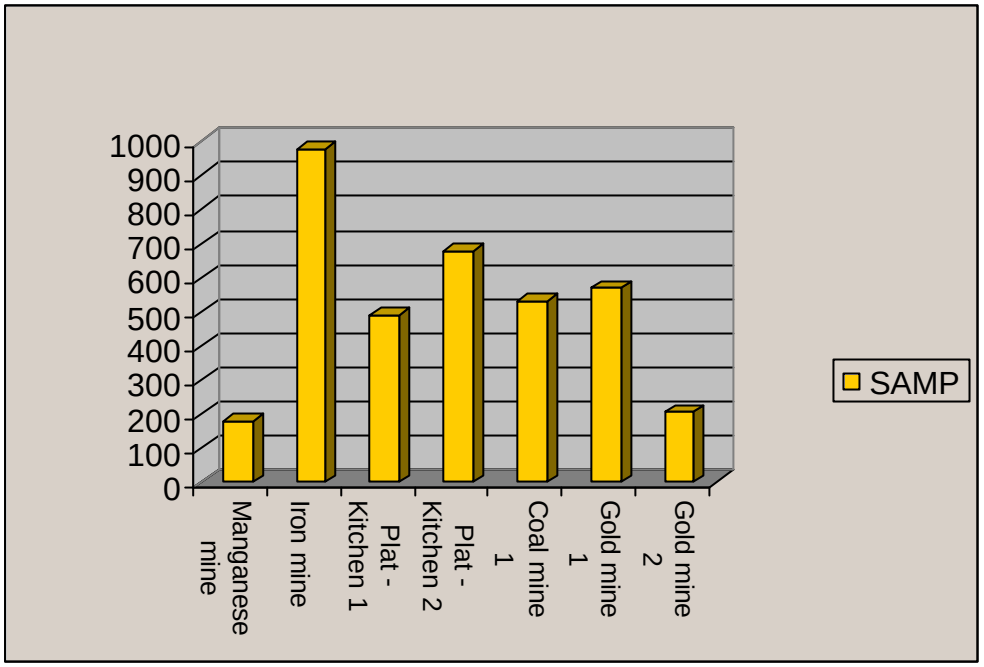


Figure 4.8.3.2: Average portion sizes (in grams) of samp served to hostel dwellers at the different mines

Figure 4.8.3.2 presents the average portion sizes of samp for the seven hostel kitchens surveyed. On average, 60% of the hostel dwellers requested samp for their main meal. Again hostel dwellers at the Iron Mine took an average of 976 g of samp, while the hostel dwellers at the Manganese Mine took 178 g on average.

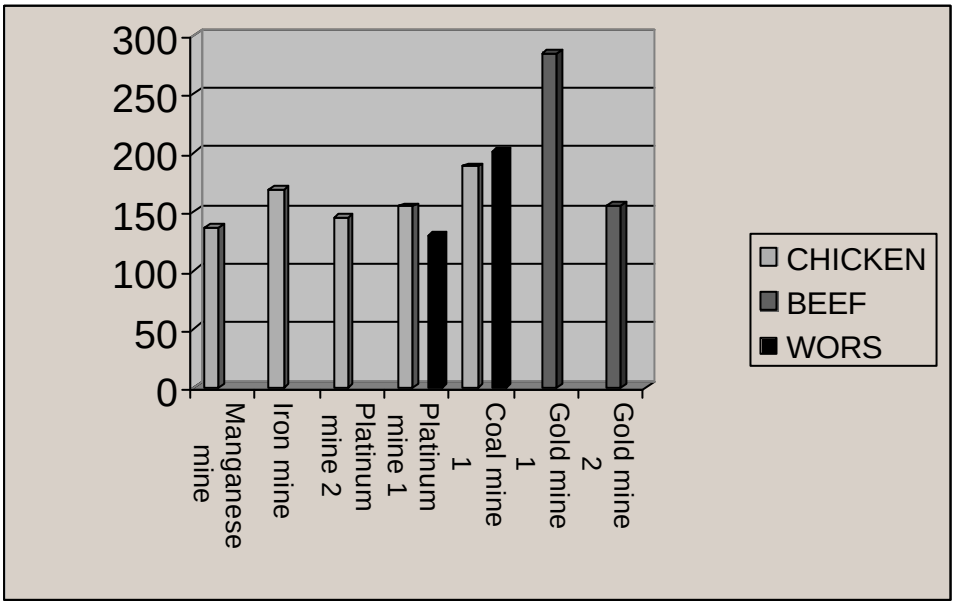


Figure 4.8.3.3: Average portion sizes (in grams) of meat served to hostel dwellers at the different mines

From Figure 4.8.3.3, four of the kitchens served chicken, two served beef and two served wors. The average portion of chicken weighed 158 g, with Coal Mine 1 serving the largest portion (with an average weight of 188 g). There is a great difference between the weight of beef served at the two gold mines. This was because at Gold Mine 1 the ratio of bone to meat was higher than at Gold Mine 2. All hostel dwellers surveyed took meat. At the mines where there was an option of taking chicken or wors (i.e. Platinum Kitchen 2 and Coal Mine 1), 30% of coal mine dwellers and 90% of platinum hostel dwellers chose chicken; the rest chose wors. The portions of wors at the Coal Mine 1 were bigger than at the Platinum Kitchen 2.

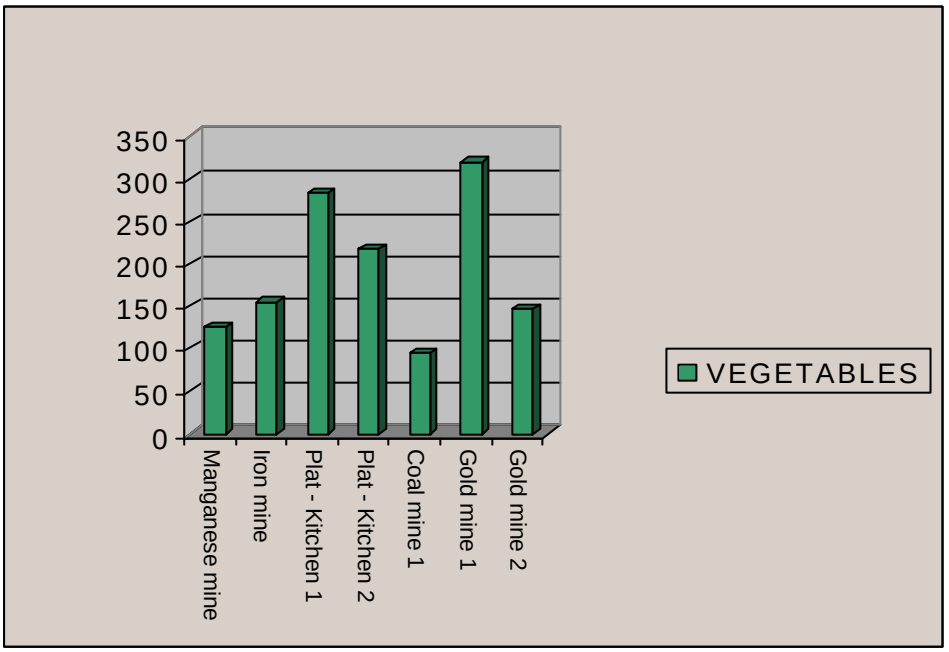


Figure 4.8.3.4: Average portion sizes (in grams) of vegetables served to hostel dwellers at the different mines

In Figure 4.8.3.4, the large difference in the average portion sizes of vegetables is evident. This is probably because the amount served by the kitchen staff tended to be conservative, allowing only one spoonful per mineworker, where with pap and samp he could request more than one serving. On average, 88% of the hostel dwellers surveyed requested a vegetable dish as part of their main meal.

5. Conclusion

Hostel dwellers and non-hostel dwellers were of normal mass for height according to the average BMI for each group. A large percentage of the non-hostel dwellers (42%) never ate before work and 30% of non-hostel dwellers did not take food to work with them. Conversely most of the hostel workers (73.5%) ate breakfast, while a large percentage (54%) did not take food to work. Most hostel workers ate twice a day compared to non-hostel workers who usually eat three times a day.

Hypertension and diabetes was prevalent among the study participants (especially hypertension). Hypertension and diabetes were more prevalent among non-hostel dwellers than hostel dwellers, while a history of TB was more common among hostel dwellers than non-hostel dwellers. Special diets for mineworkers with hypertension and/or diabetes were only provided at certain mines.

Low energy intakes found in this study could be a reflection of the limitations of the 24-hour dietary recall methodology used for the collection of dietary intake data. The 24-hour recall is known to underreport dietary intake and evaluation of the ratio of recorded energy intake divided by estimated basal metabolic rate indicated that at eight of the ten mines the magnitude of under-reporting was substantial. Dietary intakes over the weekend were also probably not reflected sufficiently in the study and people are known to eat and drink more during weekends. The latter could have contributed to the low mean energy intakes on weekdays found in this study.

Analyses of the dietary intake of mineworkers showed that they followed a diet typical of African men living elsewhere in South Africa. The percentage of energy from carbohydrate was high, while the percentage of energy from fat was low to moderate, and protein intakes met the guidelines for a prudent (healthy) diet. Despite the high carbohydrate intake, the fibre intake was low, which indicated that refined carbohydrates were mainly consumed. Fat intakes at some mines are, however, approaching 30% of energy intake, and care should be taken to encourage mineworkers at these mines to choose foods that are not high in fat; they should avoid saturated fatty acids, particularly. The diets of those following a very low fat diet are of concern and attention should be given to the diets of these mineworkers to ensure that they consume enough fat to meet their essential fatty acid requirements.

Although the mineworkers' diet seems generally to meet the requirements of a prudent diet in terms of the distribution of energy from macronutrients, dietary fibre and micronutrient intakes were inadequate. The low intake figures for micronutrients, especially the B-vitamins, could to some extent be the result of underreporting. Other factors could also have contributed to the inadequate intakes; e.g. the food composition tables used for the analyses of the dietary data may have missing values for some nutrients and the provision for fortified foods was not made. Nevertheless, the very low intakes of vitamin C, vitamin A and potassium, especially, warrant further investigation. An inadequate intake of vegetables and fruit could have contributed to these inadequacies. Fruit and fruit juice do not feature very often on the menus at the mines, although there are exceptions. Vegetable portions also tend to be limited and the variety of vegetables offered may play a role in the low vitamin C and vitamin A intakes reported. The possibility also exists that although vegetables and fruit are offered, mineworkers do not eat these foods.

There are indications that the diet of the non-hostel dwellers is slightly better than that of the hostel dwellers. Vitamin A and vitamin C intakes were significantly higher in non-hostel dwellers than in hostel dwellers. This could indicate that non-hostel dwellers had access to a wider variety of foods than the hostel dwellers did.

It could be concluded that the diet of mineworkers met the prudent dietary guidelines for macronutrients, with the exception of dietary fibre. However, the low intakes of micronutrients are of concern and the effect of this should be investigated further. Analyses of the dietary intake of mineworkers showed that they followed a diet typical of African urban men in South Africa.

6. Recommendations

6.1 Food-Based Dietary Guidelines for the mining Industry

The Food-Based Dietary guidelines (FBDG) based on the existing consumption of locally available foods in South Africa, can be adopted for the mining industry. The FBDGs consist of 10 short clear and simple messages, which have been tested for comprehension, appropriateness and applicability in consumer groups of different ethnic backgrounds in both rural and urban areas (Vorster HH et al.., 2001). The guidelines are:

- Enjoy a variety of foods
- Be active
- Make starchy foods the basis of most meals
- Eat plenty of fruit and vegetables
- Eat dry beans, peas, lentils and soya often
- Meat, chicken, fish, milk and eggs can be eaten every day
- Eat fats sparingly
- Eat foods and drinks containing sugar sparingly and not between meals
- Drink lots of clean, safe water
- If you drink alcohol, drink sensibly and not the day/night before the shift.

The intake of vegetables and fruit should be increased. It is accepted that fruit/ vegetables may be relatively expensive and this may limit the number of times a serving is offered on the menu. However, the kitchen manager planning the diet, in consultation with a dietician, may solve the problem by planning a menu with fruit/vegetables in season or introduce fortified foods or/and drinks, which provide the mineworkers with the required micronutrients.

When energy intake is very limited, fat and lean tissue mass (i.e. protein) are used by the body as fuel. Loss of muscle results in the loss of strength and endurance. High and efficient performance is not possible when only fat is utilised for energy. ***Mineworkers should be provided with a daily carbohydrate intake of 7-10 g/kg body mass to ensure restoration of muscle glycogen stores between shifts and the practice of feeding a high carbohydrate meal at the end of the day's shift should be standard.***

Protein requirement for mineworkers should be 1.45 g/kg. Protein requirements are slightly increased in highly active people. Protein recommendations for endurance athletes are 1.2 to 1.4 g/kg body weight per day, whereas those for resistance and strength-trained athletes may be as high as 1.6 to 1.7 g/kg body weight per day.

Lack of variety is a concern. However, if the amount spent on food by the individual is spent at the hostel kitchen, then a greater variety could be provided. It may be that the variety is limited because the mineworker's choice of food is limited. Choice is a complex issue that may be limited by income and/or priorities.

6.2 Nutrition and hydration during physical work in heat

Optimum hydration is best achieved by drinking relatively small amounts of water at relatively short intervals, e.g. about 350-500ml every 30 minutes. Basic physiological requirements are effectively met by ordinary tap water. Availability and palatability of water are important. An optimum temperature, in terms of palatability, is 15°C. It has also been shown that heat acclimatisation in the South African gold mining industry could be accelerated by vitamin C supplementation and that the required level is 250mg per day.

Both alcohol and caffeine-containing beverages significantly increase diuresis and therefore counteract full rehydration (Kielblock, 2001). Worker education regarding use of both beverages is, therefore, essential.

6.3 Hydration and nutrition before, during and after work

Both energy intake and the timing of intake are important variables for optimising the mineworker's wellbeing and performance during many hours of prolonged hard work. Carbohydrate feeding studies suggest that carbohydrate drinks can increase energy intake of soldiers during field operations and increase the likelihood of sustained performance when food supply is limited or inadequate food intake is likely.

6.3.1 Pre-shift feeding

Two hours before the shift 400 – 600 ml of fluid (water, milk etc.) should be consumed. A meal or snack should provide sufficient fluid to maintain hydration; be relatively low in fat and fibre to facilitate gastric emptying and minimise gastrointestinal distress; be relatively high in carbohydrates to maximise maintenance of blood glucose; be moderate in protein; and be composed of foods familiar to and well tolerated by the mineworker.

6.3.2 Midshift feeding

During exercise, 150 – 350ml of fluid (containing carbohydrates) should be consumed every 30 minutes depending on tolerance. The primary goal is to provide carbohydrates (0.7g carbohydrates/kg body weight per hour or approximately 30-60g per hour) for the maintenance of blood glucose levels. These nutritional guidelines are especially important for mineworkers doing strenuous exercise, when the mineworker has not consumed adequate food or fluid before exercise, or if the mineworker is exercising in an extreme environment (heat, cold, or altitude).

Perishable food high in protein is temperature sensitive; therefore, such food may be a safety/health risk if taken or kept underground if the environmental temperature is warm/hot (see to appendix 8.13). Radiation, especially in gold mines, dust and diesel may contaminate food handled by mineworkers due to poor hygiene. Often this is unavoidable. Food should, therefore, be sealed and consumed with as little handling as possible (Bredenhann E, personal communication).

The following criteria can be used for midshift feeding (Bredenhann E, personal communication):

- Acceptable to the worker
- Should provide +/- 15-20% of the daily energy need (in order to ensure that the midshift feed is not used instead of a balanced breakfast or main meal)
- Safe product
- Easily digestible
- Not easily contaminated
- Packaging should not cause unnecessary littering or any other hazards such as a fire hazard

6.3.3 Post-shift feeding

Optimal rates of carbohydrate (glycogen) storage are achieved at a total intake of about 7-10 g/kg body mass over a 24-hour period, i.e. 500-700g of carbohydrates for an average build (70Kg).

6.4 Education

The issue of changing eating habits may be problematic. For example, mineworkers apparently dislike brown bread with wheat germ because it gives them dyspepsia and dislike vegetables raw or semi-raw while chips are preferred to boiled potatoes (Williams, 1942). Personal preferences motivated by taste, culture and social habits, persuasive product marketing, family pressure, availability and cost are all potent influences on the mineworker's choice.

The perceptions that healthy food is tasteless and 'uninteresting' can only be effectively tackled by providing healthy food that also tastes good with an education programme that promote healthy eating and stresses the importance of a healthy diet to ensure optimal health. Relevant programmes and educational material on food and feeding should also be developed for each mine and used as part of the training.

To encourage mineworkers to adapt to healthier eating habits requires a multifaceted approach with participation of:

- All those involved in the food supply chain
- Community organisations
- Local and provisional authorities, including social departments
- Employers
- Schools
- The media
- Consumer organisations
- The voluntary sector
- Labour

The media are the most likely source of information on nutritional issues and, therefore, have enormous potential to influence dietary behaviour. Consumers are subjected to a vast array of food product advertisement, promotional material and dietary advice, some of it conveying conflicting or misleading messages about the benefits or disadvantages of certain foods. There is a need to ensure that the healthy eating messages, which they promote, are accurate, consistent and reflect the South African food-based dietary guidelines.

The workplace offers a prime opportunity for increasing consumer's awareness of healthy eating. Employers are in a position to offer an environment in which to encourage employees to make healthy eating choices. It is a challenge for those in charge of hostel

kitchens to provide a wide selection of healthy foods based on the FBDG for South Africa. Hostel kitchens can provide a wide selection of healthy snacks. Mine health and safety committee at the mines should negotiate with vendors to sell healthy snacks and do the relevant promotion. Staff notice boards can usefully display information about dietary issues and healthy eating.

To avoid food poisoning, education on food preparation, storage and personal and environmental hygiene should be included.

6.5 Food Purchasing

The buyer is likely to be mainly concerned with price rather than quality, unless proper standards are available. For example, old potatoes have much less vitamin C than those that are fresh; old carrots contain far more indigestible fibre than young ones.

Details required for the food specification for each item of food ordered by the kitchen should be drawn up to comply with Foodstuffs, Cosmetics and Disinfectants Act, 1972 as well as food safety issues dealt with in the Health Act, Act 63 of 1977 (see appendix 8.14). Food would then be purchased in terms of the food specifications and not on price.

R908 of 27 June 2003 under the Foodstuffs, Cosmetics and Disinfectants Act, 1972 deals with regulations relating to the application of the Hazard Analysis and Critical Control Point System in Food Service Units as well as Food Manufacturers. This ensures that the food supply chain is controlled with regards to food safety and quality.
This includes the following:

- Source – Supplier compliance with R918 under the Health Act (Act 77 of 63) (Public Health Involvement) Also compliance with the Environmental Management Act as well as the Water Act to ensure proper waste and water management (To avoid later liabilities)
- Procurement Control – Food Specifications, (Compliance with the Foodstuffs, Cosmetics and Disinfectants Act: Act 54 of 1972 as amended) market related prices, contracts
- Buying- value for money (Nutritional guidelines, packaging, dilutions, mixing, pre-preparation methods etc)

6.6 Food Fortification

Manufacturers and suppliers have approached many mining groups with products, which are fortified claiming they have micronutrients that provide the correct nutritional requirements for mineworkers. ***It is essential to obtain objective data, if these are available.*** Typically, there are no data from clinical trials or intervention studies by recognised independent institutions verifying these claims and, in some cases there are no data substantiating the content of the products or the bioavailability of the micronutrients. Health claims cannot be made without the necessary scientific references (Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972).

Another concern is that the products are often issued just before workers start their shift, and the mineworker takes the product into a dirty, dusty environment, which will result in contamination of the product and a possible food safety hazard. The practicality of issuing the food during a shift as well as the packaging and shelf-life are important points to consider.

It is recommended that all suppliers or manufacturers of these products have their product/s tested by a recognised independent institution, and conduct intervention studies on a similar workforce to confirm their claims. Special attention to the side effects and perceptions of the product by the user should be obtained and in terms of compliance and acceptance of the product at the mine. In addition, the use of the product (how, when, where) must be specifically addressed. It may prove worthwhile, in terms of cost and nutritional content, to rather provide a carbohydrate drink or fruit instead of a fortified food product.

6.7 The need for appropriate supervision in Hostel Kitchens

The kitchen overseer/manager should be thoroughly instructed in the job (Regulations Governing General Hygiene Requirements for Food Premises and the transport of Food; section 10). He/she should have appropriate knowledge of food, cooking and sufficient mathematical knowledge to compute food quantities required to complete the food control sheets.

The services of dietetic consultants are recommended to assist with menu planning that meets the nutritional requirements of the mineworkers including mineworkers with chronic

illnesses or other special needs. The dietetic consultant could also assist in the training of kitchen staff in terms of food preparation. This will include the development of recipes specific to each kitchen (based on the strengths i.e. the number of people served and likes of the mineworkers). Regular monitoring and evaluation will be required.

6.8 Hostel kitchen risk analysis and management

There are risks at each stage of the food supply (section 6.5), delivering, storage, preparing, cooking and waste. The hazards at each stage need to be identified, described and controlled. If control is not maintained, the responsible person should ensure that the corrective action is taken (Bredenhann E, personal communication). A food policy should be drawn up. For example,

Dry storage

Hazard: Microbial, chemical and physical

Description: Pest infestation, contamination and product degradation

Control measures: Temperature control, stock rotation, good housekeeping, and hygiene standards.

Limits: 15-21?C, zero tolerance

Corrective action: Control ventilation/ no staking in front of window/door, re-stack, and report to hostel manager

Person responsible: Supervisor or hostel manager

A similar risk analysis and management could be done for;

- Receiving food
- Cold rooms
- Deep Freeze
- Pre-preparation
- Preparation
- Cooking
- Holding
- Serving
- Food Wastage
- Sanitation

An external audit, as had been done by the DME at one of the hostel kitchens, is recommended.

6.9 Cooks

Cooks should be appropriately selected, and trained and supervised. Many cooks have been appointed without any sort of previous cooking experience or training. Regular medical examinations and relevant tests should be carried out whenever clinically or epidemiologically indicated (SABS 049-1989). Clause 11 of R918 under the Health Act states:

Duties of a Food Handler:

11. (1) Food, a facility or a container shall not be handled by any person-

a. whose fingernails, hands or clothes are not clean

b. who has not washed his hands thoroughly with soap and water or cleaned them in another effective manner-

i. immediately prior to the commencement of each work shift

ii. at the beginning of the day's work after a rest period

iii. after every visit to a latrine or urinal

iv. every time he or she has blown his or her nose or after his or her hands have been in contact with perspiration or with his or her hair, nose or mouth

v. after handling a handkerchief, money or a refuse container or refuse

vi. after handling raw vegetables, fruit, eggs, meat or fish and before handling ready to use food

vii. after he or she has smoked or on return to the food premises

viii. after his or her hands have become contaminated for any other reason.

6.10 Batch Cooking

Most hostel kitchens prepare all the food for the day at the same time, with the consequence that the food for late comers is invariably stewed to a point where it is certainly not as valuable from the nutritional aspect as food cooked for a shorter time. A daily progressive census of meals should be made hour by hour for, say, one or two months in each hostel kitchen to determine what maximum demand on the kitchen capacity may be expected at any hour on any day, providing there is no radical change in the hours of shifts on the mines. In this way, the preparation and cooking of food may be regulated to supply the demand at regular intervals. Such regulation is especially necessary in the preparation and cooking of foodstuffs such as meat, vegetables and beans where vitamins are destroyed after long heating.

6.11 Bad organisation of food issues

Mineworkers are tired and irritated by unequal access to food. Those who are delayed underground may find that the best food has gone and there is no choice or insufficient food left. The nutritional content of food kept warm for prolonged period is also a concern (refer to R918 under the Health Act).

6.12 Food being thrown away or consumed by persons not employed by the mines (food wastage)

The amount, the type and the cause of food waste should be investigated. Waste food indicates that either too much of a particular food item is being issued, or that the food is not being consumed. If mineworkers are permitted to take food back to their hostels, information on food wastage is not available. The other concern is that food is not being consumed by the mineworker, himself, but may be being sold/given to persons not employed at the mine. This was evident in hostel kitchens where mineworkers sold meal tickets to people living in the community around the mine.

All mineworkers should consume their food at the hostel kitchen where proper hygiene can be maintained and food consumed can be more accurately monitored.

6.13 Recommendations for further research

If further research into the nutritional status of mineworkers is considered necessary, it is recommended that studies make use of repeated 24-hour recalls to collect dietary information on habitual dietary intake. The collection of data for two days during the week and one day during the weekend is recommended. The repeated 24-hour recall method allows the study of smaller number of people. Additional information on the frequency of the consumption of specific foods could be collected by a study specific validated food frequency questionnaire. The latter could be developed based on the food intake information collected by means of the 24-hour dietary recall method used in this study.

To investigate the link between dietary intake and work-related injuries, a case control study design is recommended. The case control study should focus particularly on the nutritional inadequacies observed in this cross-sectional study. Biochemical biomarkers

should be included to link inadequate intakes of micronutrient deficiencies to health profiles and to the risk of injury.

The associations between antioxidants, for example vitamin C and HIV are very important and there is a great need for further research in these areas, especially in terms of establishing an ideal source of antioxidants for mineworkers.

Information on consumption is available at the hostel kitchens as part of their stock control procedures. As cost control is important, these figures are usually reliable to not only determine cost of the meal per mineworker but also, on average, consumption per person at each hostel kitchen. Since this information is specific for each mine, it is, recommended that each mine carry out such a study as operational research.

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8. Appendices

8.1 Consent form for miners taking part in 24-hour recall questionnaire and KAP study

8.2 24-hour recall questionnaire and KAP study

8.3 Consent form for interview with hostel manager

8.4 *In situ* questionnaire for nutrition

8.5 Report at Diamond Mine

8.6 Report of hostel kitchen at Manganese Mine

8.7 Report of hostel kitchen at Iron Mine

8.8 Report of hostel kitchen at Platinum Mine

8.9 Report of hostel kitchen at Coal Mine 1

8.10 Report of hostel kitchen at Gold Mine 1

8.11 Report of hostel kitchen at Gold Mine 2

8.12 Report at Coal Mine 2

Appendix 8.1: Consent Form For Miners Taking Part In The KAP Study And 24-Hour Recall Method Questionnaire

SIMRAC NUTRITION PROJECT

SUBJECT: INFORMATION SHEET and REQUEST FOR CONSENT FROM MINE EMPLOYEES AND MINE EMPLOYERS

Dear Sir/Madam

Re: Catering arrangements at _____ mine

Hi, my name is Dr Belinda Dias. We would like you to take part in our research project, which this mine has agreed to help me and my research team with. It is a SIMRAC (Safety in Mines Research Advisory Council) project to see if the food and fluid you eat and drink is enough to keep you healthy and give you all the energy you need to perform your work in the mine.

A member of the research team will ask you some questions about all the food and fluid you ate and drank over the past 24 hours. We would also like to know how you feel about the food you eat and how you think food may or may not affect your health.

The research team member will not take your name, and any information you tell him will be kept in strict confidence and will not be passed on to anyone outside the small research team.

Taking part in the study is voluntary and not taking part will not affect your employment in any way. You are free to refuse to take part or to stop taking part in the interview at any time. If you agree to participate, please answer the questions as honestly as you can. Your opinions are very valuable, so feel free to express them. If you want more information about the study or if you have any questions please ask the research team member.

Dr B Dias

INFORMED CONSENT FORM

I, Mr/Mrs _____ do hereby agree to participate in the study being undertaken by Dr Belinda Dias regarding nutrition in the mines. It has been explained to me and I do understand that this study is purely for research purposes.
I also understand that I have the right to withdraw/discontinue my participation at anytime, if I may decide otherwise.

Consent given: ☐

Date: _____ **Researcher:** _____

Date: _____ **Participant:** _____

Appendix 8.2: The 24-hour recall questionnaire and KAP study

Section A

General information

1. Case study number: _____ 1 ☐☐☐

2. Date of interview _____/_____/20____
   dd mm yy

3. Name of interviewer _____ 3 ☐

4. Patients industry no.:_____ 4 ☐☐☐☐☐☐

   a. Contractor/ Permanent
   b. Name of contractor_____

5. Name of mine/quarry _____ 5 ☐☐

6. Date of birth: ___/____/19____ or approximate age in years: _____ 6 ☐☐
   dd mm yy

7. What is your home language: _____ 7 ☐☐

8. Highest level of education: _____ 8 ☐☐

9. What is your job description:_____ 9 ☐☐☐☐☐☐

10. What work do you do most of the time: _____

_____

Section B

Anthropometric measurements

11 Height_____m 11 | | | | |

12 Weight_____kg 12 | | | |

13 Body fat percentage:_____% 13 | |

14 BMI_____ 14 | |

Section C

Nutrition and housing

15 Do you get an allowance for food? **Yes / No**

If yes, how much do you get? R_____ 15 | | |

16 Do you get an allowance for accommodation? **Yes / No**
If yes, how much do you get? R_____ 16 | | |

17 Do you get an allowance for transport? **Yes / No**

If yes, how much do you get? R_____ 17 | | |

If NO, go to question 18

18 Approximately how much money do you spend a month on:

i. Food R_____ 18 i | | |

ii Accommodation R_____ 18 ii | | |

iii. Transport R_____ 18 iii | | |

19 Where do you live now? 19 |

a. Hostel if you circled **a** go to question 33
b. Other if you circled **b** go to question 20

20 Do you stay at 20

a)	Skoonspruit	_____km	j)	Churchill	_____km
b)	District 6	_____km	k)	Bendell	_____km
c)	Tfineng	_____km	l)	Oomslag	_____km
d)	Maruping	_____km	m)	Farm-Mshwanig	_____km
e)	Laxey	_____km	n)	Magobing	_____km
f)	Pepsi	_____km	o)	Magojaneng	_____km
g)	Gamopedi	_____km	p)	kathu	_____km
h)	Penrym	_____km			
i)	Other	(specify) _____			

21 In what type of house do you live? 21

1 Built formal house
2 Flat
3 Tent
4 Informal shack/shelter
5 Other (specify) _____

22 How many rooms does your accommodation have (excl. kitchen & bathroom)? ___22

23 How many other people do you share a room with? _____ 23

24 Are there cooking facilities available? **Yes / No** 24

25 How do you cook your food? 25

1 Electricity (stove / electrical plate)
2 Gas
3 Fire
4 Paraffin
5 Other (specify) _____

26 Do you have a fridge were you stay? **Yes / No** 26

27 Who makes the food? 27

1 Self
2 Wife
3 Daughter
4 Grandmother
5 Girlfriend
6 Other (specify) _____

28 Do you usually eat 28

Before the shift **Yes / No**

After the shift **Yes / No**

A third meal **Yes / No**

If you answered yes to one of the following meals, please compete the attached Questionnaire

29 If you do not eat at home, where will you usually go to get something to eat? 29

_____

_____

30 How do you get to work? _____ 30

31 How long does it take you to get to work (including waiting and travel time)? _____ 31

32 How many kilometres do you travel to get to work?_____ 32

GO TO Q45

33 What is the name of the hostel?_____ 33

34 How do you obtain your food at the hostel? 34
1) Buy a meal ticket
2) Credit card system
3) Swipe your card to get into the kitchen
4) Pay with money the food items you want to eat
5) Don't eat at the hostel
6) Other (specify) _____

35 How many meals a day on average do you have from the hostel kitchen? 35
1) 1 meals a day
2) 2 meals a day
3) 3 meal a day

36 How many times a week do you eat at the hostel kitchen? 36
a) Always
b) Most of the time (five or more times a week)
c) Sometimes (four or less times per week)

37 Do you stay in: 37
i. single sex room
ii single quarter
iii family quarter
iv other describe _____

38 How many other people do you share a room with? _____ 38

39 Do you prepare food in your room? Yes / No If NO go to question 42 39

40 If yes, how do you cook the food? 40

_____

_____

41 What do you usually make to eat? 41

_____

_____

_____

42 How do you get to work? _____ 42

43 How many kilometres do you travel to get to work?_____ 43

44 How long does it take you to get to work (including waiting and travel time)?

_____ 44

45 How many kilometres do you travel to get to work?_____ 45

Section D

Food Habits

46 How often per week, do you drink vitamins or mineral supplements? _____ 45 ☐

a) Never (go to Q47)
b) Always
c) Most of the time (five or more times a week
d) Sometimes (four or less times per week

47 If YES what is the name of the vitamin/mineral supplement you take? 46 ☐☐

_____

48 How often per week, do you drink traditional medicine? 47 ☐

a) Never (go to Q49)
b) Always
c) Most of the time (five or more times a week)
d) Sometimes (four or less times per week

49 If YES what is the name of the traditional medicine that you take? 48 ☐

_____

50 How often do you eat and/or drink something before you go to work? 49 ☐

a) Never
b) Always
c) Most of the time (five or more times a week)
d) Sometimes (four or less times per week)

51 How often do you take something to eat and/or to drink to work? 50 ☐

a) Never
b) Always
c) Most of the time (five or more times a week)
d) Sometimes (four or less times per week

52 How often do you feel hungry when you are at work? 51 ☐

a) Never
b) Always
c) Most of the time (five or more times a week)
d) Sometimes (four or less times per week

53 Have you ever experienced any of the following symptoms while working? 52 ☐☐

a) light headed Yes / No *If Yes WHEN* _____
b) faint Yes / No *If Yes WHEN* _____
c) Muscle cramps Yes / No *If Yes WHEN* _____

If No go to q54

54 How often have you experienced light headedness, faint and/or muscle cramps? 53

a) Every shift
b) Five or more times a week
c) Four or less times per week
d) Once a month
e) Once in the last year

55 If you take something to eat and/or to drink to work, what do you take most of the time 54

What do you take to eat and drink	Source? (From where is food obtained?)	How much? (Quantity)

56 Are you a vegetarian? **Yes / No** 55

57 Have you ever been treated for TB? **Yes / No** 56
If YES, When were you treated? _____

58 Do you have any of these medical conditions? 57

1) Diabetes
2) Hypertension (high blood pressure)
3) Other (specify) _____

59 Have you received compensation while working at the mine for any injury or disease? **Yes / No** 58 i
If YES, when and for what were you compensated? _____

_____ 58ii

60 Do you drink alcohol? 59

a) Never
b) Only during the week
c) Only during the weekend
d) During the week and over the weekend

61 How much over the week do you drink? 60 ☐☐☐

DAY	Traditional BEER (mls)	Commercial BEER (mls)	WINE (in mls)	SPIRIT (in mls)
MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
FRIDAY				
SATURDAY				
SUNDAY				

62 Do you smoke? **Yes / No** 61 ☐

63 If no are you an ex-smoker? **Yes / No** 62 ☐

64 How many cigarettes did/do you smoke a day? _____ 63 ☐☐

65 For how many years do you / did you smoke? _____ 64 ☐☐

66 Which year did you stop smoking? _____ 65 ☐☐

Section E

KAP Study

67 What food do you think is good for you?

_____

_____

_____

68 How many meals a day do you eat? _____

69 What foods do you not like?

_____

_____

70 What foods do you like?

_____

_____

71 Do you think that the food that you eat ensures that you are able to do your job well?

_____

_____

72 Do you have easy access to food whenever you are hungry? Yes / No

73 Have there been any issues concerning food at this mine? Yes / No

If YES, What have been some of the issues? _____

_____

_____

74 How often per week, do you go to work without eating?

a) Never
b) Always
c) Most of the time (five or more times a week)
d) Sometimes (four or less times per week)

If they are staying in the hostel please ask the following two questions or else go to the 24-hour recall!!

75 How do you find the food that is provided by the mines in terms of :

Cost	**cheap / affordable / expensive**
Smell	**bad / haven't noticed / good**
Taste	**poor / not bad / good**
Appearance	**poor / not bad / good**
Variety	**very little / not bad / good**
Accessibility to the kitchen	**not easy / haven't found any problems / always open when I need to eat**

76 What would you change about food at this mine? _____

_____

_____

Section F

24-hour recall questionnaire

Dear Sir/Madam

I would like to ask you about the food that you ate and drank yesterday, from the time you got up until you went to bed last night. Please tell me at about what time did you have the first thing to eat or to drink; what was it; how was it prepared (if applicable); and how much was it?

1. CASE NO _____

2. DATE ____/____/20____
dd mm yy

3. INTERVIEWER _____

4. DATE OF BIRTH ____/____/19____
dd mm yy

5. AGE_____

6. Did you work on the mine yesterday? **Yes / No**

7. What day of the week was yesterday?

a) Monday
b) Tuesday
c) Wednesday
d) Thursday
e) Friday
f) Saturday
g) Sunday

8. What shift were you working? _____

What time did it start_____h___

What time did it end?_____h____

TIME	SOURCE	WHAT DID YOU EAT AND DRINK	HOW WAS IT PREPARED	HOW MUCH? (Quantity)

Appendix 8.3: Consent form for interview with hostel manager

SIMRAC NUTRITION PROJECT

SUBJECT: INFORMATION SHEET AND REQUEST FOR CONSENT FROM HOSTEL MANAGER

Dear Sir/Madam,

Re: Catering arrangements at _____ mine

Hi, my name is Dr Belinda Dias. I would like you to take part in our research project, which this mine has agreed to help me and my research team with. It is a SIMRAC (Safety in Mines Research Advisory Council) project to see if the food and fluid provided to the miners by your facility is sufficient to keep them healthy and give them all the energy they need to perform their work in the mine.

A member of the research team will ask you some questions about the menu and food preparation, food rations provided to the miners, as well as the hours the kitchen is open.

The research team member will not take your name, and any information you tell him will be kept in strict confidence and will not be passed on to anyone outside the small research team.

Taking part in the study is voluntary and not taking part will not affect your employment in any way. You are free to refuse to take part or to stop taking part in the interview at any time. If you agree to participate, please answer the questions as honestly as you can. Your opinions are very valuable, so feel free to express them. If you want more information about the study or if you have any questions please ask the research team member,

Dr B Dias

INFORMED CONSENT FORM

I, Mr/Mrs _____ do hereby agree to participate in the study being undertaken by Dr Belinda Dias regarding nutrition in the mines. It has been explained to me and I do understand that this study is purely for research purposes.
I also understand that I have the right to withdraw/discontinue my participation at anytime, if I may decide otherwise.

Consent given: ☐

Date: _____ **Researcher:** _____

Date: _____ **Participant:** _____

Appendix 8.4: *In situ* questionnaire for nutrition

Medical Research Council

Nutritional Intervention Research Unit

DRAFT Questionnaire

Food consumption survey at official food outlets on South African mines

The aim of this questionnaire is to collect information on the provision of food to mineworkers through official food outlets at the mines.

The information is confidential and will only be used for research purposes.

(This questionnaire will be completed in collaboration with the person in charge of the provision of food (food service manager and cook) at the food service outlet.)

Date: .....

Name of mine Code		

Fieldworker Code		

SECTION A

1. Do you have a ration scale for providing food to the mineworkers?

YES = 1 (YES ask for a copy, go to 2)		NO = 2 (Go to 4)		UNSURE = 9 (Go to 4)		

2. If YES do you follow the ration scale?

YES = 1 (YES, go to 4)		NO = 2 (Go to 3)		UNSURE = 9 (Go to 4)		

3. Why do you not follow the ration scale?

.....

..... **Unsure/Do not know = 9**

4. Do you have a set menu which you follow for the provision of food at the mines?

YES = 1 (YES ask for a copy, go to 6)		NO = 2 (Go to 5)		UNSURE = 9 (Go to 6)		

5. Please describe to me what you usually serve to the mineworkers for:

Breakfast	
Lunch	
Supper	
In-between meals	

6. How much money per individual per day is available for the provision of food?

Do not know = 00000					

7. How many portions of vegetables (including salad, excluding potatoes) do you usually serve per individual per day? (One portion = ½ cup)

8. How many portions of fruit do you usually serve per individual per day? (One portion = one medium banana/ one apple/ one orange/ small bunch of grapes/ etc.)

9. How many times per day do you serve animal protein (e.g. red meat/chicken/fish) with a meal?

Do not know = 99		

10. How many slices of bread are served per individual per day?

Do not know = 99		

11. What type of bread do you serve most of the time?

1. White bread (shop)	
2. Brown bread (shop)	
3. Whole wheat (shop)	
4. White bread (home baked)	
5. Brown bread (home baked)	
6. Whole wheat (home baked)	
7. Vetkoek	
8. Other (specify)	

12. What do you serve most of the time to spread on the bread? (Mark more than one if there is not a clear indication that a specific spread is mainly used.)

1. Hard brick margarine	
2. Soft tub type margarine	
3. Butter	
4. Animal fat	

5. White margarine e.g. Holsum	

6 . Peanut butter	
7. Jam	
8. Other (specify)	

13. How often per week is a glass of milk (approximately 250 ml) served per individual?

Do not know = 99 Never = 00 Number of times per week		

14. How often per day/week do you serve the following?

1. Maize meal porridge	**Day**	**Week**				
2. Potatoes						
3. Rice						
4. Bread						
5. Pasta						
6. Other (specify)						

15. What is the staple food on the menu?

(The food item that forms the bulk of meals and is served most of the time)

1. Maize meal porridge	
2. Potatoes	
3. Rice	
4. Bread	
5. Mixed diet	
6. Other **(Specify).....……**	

16. How often per week do you serve the following?

1. Beer (shop bought)		
2. Beer (home brewed)		
3. Mageu		
4. Sorghum beer		
5. Wine		
6. Brandy/whiskey/other spirits		
7. Liqueur		

8. Other **(Specify).....**		

SECTION B

Data on type of food and portion sizes of food served during meals at the mines

Meal time* (time and meal type)	Type of food	Preparation method	Average portion size in grams (weighed)

Early morning = E; Breakfast = B; In-between morning = IB-M; Lunch = L; In-between afternoon = IB-A; Supper = S; In-between after supper = IB-S.

Appendix 8.5: Report at Diamond Mine

Before 1986, the mine was responsible for feeding 6 000 mineworkers. From 1986 to 1994 a coupon system was used, and by 1994 miners were paying for 100% of the raw food items they received (approximately R2.00 for breakfast and R9.00 for the main meal). By 1994, only 1 100 meals were being prepared. The kitchen was closed in 1994 because of industrial action and was never reopened by the company. Then, in 1996, the kitchen was reopened but run by a private company. Under this company a payroll deduction was introduced. Over time, two other private companies were employed to run the kitchen. In 1999 the kitchen was closed permanently and there are no plans to introduce a feeding scheme in the future. Over the same period the hostel was converted into flats and this was completed by 1999.

There are currently 1 525 miners working at Diamond Mine. Five hundred and seventy-one of these miners are staying at the flats. The building has 900 rooms and is made up of eight blocks. Each block has a resident representative who meets with the union representative regularly. All services are provided on a contract basis. Not more than two rooms are allocated to each person to discourage subletting.

There are no available records on menu, rational scale or wastage records of the kitchens in operation between 1986 and 1999. There was also no kitchen policy or procedures available.

Appendix 8.6: Report of hostel kitchen at

8.6.1 Manganese Mine

The hostel manager accompanied the Miningtek staff member on the visit to the hostel kitchen at the Manganese Mine. At present, the mine provides the kitchen facilities and personnel.

Hostel dwellers, contractors and people staying in the guest house have access to the hostel kitchen. Mineworkers staying in single quarters go to a separate kitchen run by the mine and receive a different menu. There is only one guest house. The purpose of this guest house is for the miners to accommodate their families who are allowed to visit them at the mine on a yearly basis. The family staying at the guest house is charged to stay and eat at the guest house and this is debited from the employee's salary. Any family visiting and staying at the guest house also has access to the hostel kitchen by family members swiping their ID cards. The mine worker is only allowed into the kitchen once per meal. Once in he is allowed as many servings as he required, except for the protein serving.

The hostels used to accommodate 1 300 miners but now there are about 330 mineworkers and 100 contract workers staying in the hostel. The number of persons employed at the mine is 945. The mine transports workers to and from the hostels.

8.6.2 Hostel kitchen meals

The mine provides two meals a day: breakfast and the main meal. No food packs are provided to the mineworkers. However, many of the miners take the food from breakfast down with them when they go to work. The bread served to them is wrapped in plastic cling wrap. All the food is prepared before the official hours and is kept warm in trolleys and warmer ovens. The official breakfast hours are from 04h00 to 07h00 and from 10h00 to 10h30 from Monday to Friday. For the main meal, the times are 15h00 to 20h30 from Monday to Friday. Over weekends and public holidays the kitchen is not open between 10h00 and 10h30 but the main meal is served from 13h00 to 19h00. The kitchen is open again for the night staff for about half an hour. Miners are given bread and coffee only to eat or take to work with them. The amount for both meals for hostel dweller is R8.01 per day. This is deducted from the hostel employee's salary whether the employee has eaten or not.

There is a concern about food wastage. Approximately 9-12 drums (210 L) of food every month is wasted and sold to a pig farmer who collects the waste every day. The waste collected does not include food not consumed by the mineworkers as they take their food to their rooms.

8.6.3 Kitchen staff

The kitchen is open 24 hours a day and run by staff over three shifts. The kitchen staff consists of 21 workers with six staff members for each shift. At each shift, two staff members are involved with cleaning and four staff members with cooking. The personnel who cook also help with the dishing out of food to the miners. There are no recipe books and cooks have not received any formal training. They add seasoning according to their own tastes. A recipe book, no longer used, was found by the supervisor but was found to be very out of date. For example, it contained a recipe catering for 1 000 people that assumed the cabbages to be used would be fresh and not frozen.

A common practice observed was that all frozen food is removed from the freezer on the morning that the food is going to be cooked. The food (i.e. vegetables or meat) is placed in hot water for a few minutes to defrost. The water is continuously replaced with more hot water until the vegetables are 'defrosted'. This results in vitamins being lost as well as food not cooking properly, which was a common complaint by the miners. The kitchen does do batch cooking. The last personnel member who attended a course was in 1998 (offered by the subcontractors) on arranging food on a plate to make it presentable. The hostel manager is concerned about the training of the staff and feels that they would all benefit from attending a course. All staff members undergo medical surveillance every six months.

8.6.4 Kitchen facilities

The mineworkers provide their own eating utensils. The dining hall is made up of three big rooms, the two smaller ones have a television with DSTV for the miners to watch while they eat. Tables are available and chairs stacked up but very few miners eat here; the majority take their food to their rooms, although this is prohibited. The hostel management has concerns about hygiene and the poor facilities of the miners to keep food in their rooms.

Good stock taking and control were exercised. However, with the frozen stock, dates of issue and receipt were not always visible. The supervisor explained that, especially with frozen food, it was difficult to write dates on the packet and often a piece of paper was placed on top of the product, but that also was often not clearly visible. The shelf life of the meat and vegetables is

14 to 20 days; however, meat is usually replaced every week and bread daily, except over weekends.

8.6.5 Menu

A vegetable is served at every meal. Potatoes are considered a vegetable and are served as mash or with cabbage or spinach. Fruit is served every alternative week, with fruit juice given every other week. There is a serving of meat at the main meal.

Bread is served only at breakfast. It is always brown bread (shop bought) and is spread with margarine (Romi medium fat spread). Eight slices of bread are served to each mine worker for breakfast (04h00 to 07h00) and then again from 10h00 to 10h30. It is wrapped in a plastic wrapper and often the miners take it to work. Approximately one litre of sour pap is served and miners are free to take as much coffee / tea (which is premixed) as they want. Glasses of milk are never served. Rice is served only on Sundays, as part of the main meal. Pasta is never served. Samp is served every second day as an alternative to pap. Pap is served every day as part of the main meal. Potatoes are served twice a month.

There was no formal ration scale per meal but the amount of food ordered every week was documented and divided by the number of people staying at the hostel to determine the cost of the meal. The following portion sizes were available: chicken – 240 g, stew – 250 g, fish – 200 g, mince – 150 g, vegetables – 150 g (for pumpkin, sweet potatoes) and 70 g for carrots, cabbage, spinach and potatoes. For pap and samp etc. the miner can have as much of either as he requires.

The hostel manager had no idea how the menu was produced as it was being used when he started at the mine. He did show me the menu they had initially used but explained that it had became too expensive and, after many negotiations, they had come up with the one currently in use.

No dietician routinely consults the kitchen. A dietician was consulted last year (August 2001). This entailed faxing the current menu to her and the hostel manager spending a day with her at her consultancy in Kimberley while she formulated a report. Her basic concerns were the following:

- High fat and energy intake will lead to miners becoming overweight, to hypertension and to Non Insulin Dependant Diabetes mellitus (NIDDM).
- She mentions a correlation between high fat levels and prostrate cancer

- Meat portions should be replaced with plant proteins, e.g. beans, and cooked meat should not have visible fat.
- The ‘coffee mix’ is high in fat and has no nutritional value. Fresh milk should be used in the coffee (for at least one cup of coffee per person per day) and added to the pap.
- A protein should be added at breakfast at least twice a week.
- Fruit should be given twice a week. Since the vitamin C level is very low it may need to be supplemented with vitamin tablets containing 200 mg of vitamin C.
- More vegetables need to be added, especially green and yellow vegetables.
- The fibre count is very low and oats and corn should be added. However, the foodfundi assessment she attached states that the fibre count is adequate.
- Fresh milk should be offered.

According to her 60% of the energy the miners were receiving was in the form of carbohydrates, 10-15% was in the form of protein and 25-30% of the energy was in the form of fats.

8.6.6 Feeding committee

There is a feeding committee made up of the hostel manager, two union representatives (secretary and chairperson – both staying at the hostel) and a delegate (hostel dweller). The hostel committee meets twice a month. The feeding committee is keen to adopt the coupons system. The hostel manager feels this is not a viable option since often the coupons are sold to persons outside the mine. Many of the complaints received by the committee are about the preparation of the food; often the food is not cooked properly or is raw. Meat is said to be old and smelly.

8.6.7 Health and safety

There is a food inspector from the Department of Mineral and Energy (DME) who consults with the mine on an annual basis (she is a qualified nurse). Her comments about the kitchen have been positive and she reports it to be one of the best in the Northern Cape.

There is no formal kitchen or food policy. However a procedure document was available, which contained the following headings:

Ordering of food
Daily usages
Rules concerning the fridge and freezer
People allowed into the kitchen
Key control

Safety at the work

Garbage removal

Medical examination

Discipline

Complaints: portions and cost control

Weekly checks by the manager

Table 8.6: Menu for the hostel kitchen at the Manganese Mine

MEAL PLAN	PORTION	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
BREAKFAST								
CEREAL	1 litre	Mealie pap	Mealie pap	Mealie pap	Mealie pap	Mealie pap	Mealie pap	Mealie pap
BREAD	8 slices	Bread	Bread	Bread	Bread	Bread	Bread	Bread
SPREAD	40 g	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
BEVERAGE	500 ml	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee
MAIN MEAL: week 1								
PROTEIN	150-310 g	Chicken	Fish	Chicken	Beef	Fish	Mince	Beef
VEGETABLES	150 g	Pumpkin	Potato	Cabbage	carrots	Cabbage		
FRUIT	40 g			Fruit				
TRADITIONAL DISH	70 g	Mealie rice	samp	Mealie rice	samp	Mealie rice		
PORRIDGE	300 g	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
SOUP/GRAVY	15 g	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy
MAIN MEAL: week 2								
PROTEIN	150-310 g	Chicken	Fish	Chicken	Beef	Fish	Chicken	Beef
VEGETABLES	150 g	Potato & carrots	sweet potato	Cabbage	pumpkin	Cabbage		
FRUIT	40 g			Fruit juice				
TRADITIONAL DISH	70 g	Mealie rice	samp	Mealie rice	samp	Mealie rice		
PORRIDGE	300 g	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
SOUP/GRAVY	15 g	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy
MAIN MEAL: week 3								
PROTEIN	150-310 g	Chicken	Fish	Chicken	Beef	Fish	Chicken	Beef
VEGETABLES	150 g	Cabbage	carrots	Mash	sweet potato	Carrots		
FRUIT	40 g			Fruit				
TRADITIONAL DISH	70 g	Mealie rice	samp	Mealie rice	samp	Mealie rice		
PORRIDGE	300 g	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
SOUP/GRAVY	15 g	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy
MAIN MEAL: week 4								
PROTEIN	150-310 g	Chicken	Fish	Chicken	Beef	Mince	Chicken	Beef
VEGETABLES	150 g	Pumpkin	cabbage	Carrots	Spinach	Mash	pumpkin	carrots
FRUIT	40 g			Fruit juice				
TRADITIONAL DISH	70 g	Mealie rice	samp	Mealie rice	samp	Mealie rice		
PORRIDGE	300 g	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
SOUP/GRAVY	15 g	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy	Soup/gravy

Appendix 8.7: Report of hostel kitchen at Iron Mine

8.7.1 Introduction

The kitchen manager and kitchen administrator were interviewed. The hostel kitchens at the Iron Mine are subcontracted. They have been at the Iron Mine for seven years, the unions having been involved with the selection of the company. The subcontractor provides two meals and a food pack to the mineworkers every day, and also run a tuck shop. All mineworkers at the Iron Mine have access to the kitchen by purchasing a coupon at the office at the back of the kitchen, which is open from 8h00 to 16h00. The coupon is collected by the kitchen staff and allows the mineworker one serving of protein and as much of everything else as he needs. There are 1 300 hostel dwellers and +- 3 500 miners at the mine. The mine does provide family quarters and mineworkers can buy food coupons for the family staying with him/her.

8.7.2 Hostel kitchen meals

Two meals are provided for, namely: breakfast and the main meal, as well as a shift meal. A 'shift meal' may also be ordered. The amount charged per meal is worked out on a regular basis. The amount charged depends on the price of food ordered for that week / month. The official hours of the kitchen are 05h00 to 09h00 for breakfast, 11h00 to 13h00 and 14h00 to 22h00 for the main meal. The breakfast costs R2.79 and the main meal about R6.10. In theory, only mineworkers have access to the hostel kitchen. However, it is general knowledge that mineworkers sell their coupons to family and friends not employed at the mine. There have been occasions where mineworkers do not receive pay at the end of the month because of all the debit orders on their account from buying coupons and buying food/goods at the tuck shop. Between 50 and 60 mineworkers on average eat breakfast; 200 to 300 mineworkers eat the main meal and 10 to 20 take the food packs. Food packs are provided only during the lunch times.

Food wastage is a concern, with 8-10 kg per day of food picked up by the pig farmers, most of it starch. The amount of food wasted excludes the food not consumed by the mineworkers, as mineworkers take food to their rooms.

8.7.3 Kitchen staff

The kitchen does do batch cooking if they feel food is not going to be sufficient for the meal. However, most of the food is cooked before the meal is served. All employees received training initially (seven years ago). The employees then train new staff. There were no recipe books available and the transfer of knowledge is not documented or evaluated.

8.7.4 Kitchen facilities

Mineworkers provide their own containers and cups to receive their food (often bringing one litre bottles for the juice). There are facilities available where mineworkers can eat their meals but most choose to take their food to their rooms, although this is discouraged. Mineworkers are not allowed to cook in their rooms. There is no television available or nor are there facilities for the miners to wash their plates or hands at the dining hall.

The kitchen has a good system for stocktaking and stock control. An interesting finding not seen at other kitchens was a 'success tracking chart', which is completed every day for all activities around the kitchen. There are different charts relevantly placed at different areas; for instance, the 'managing stock control chart' would be close to the storerooms. A quick glance at this chart would highlight any problems with orders, amounts issued, etc. All stock had dates on them that stated the time of issue, and the facilities were clean. Concern of over issued stock being refrozen, placed in another fridge and forgotten could not be excluded.

8.7.5 Menu

There is a ration scale for the mineworkers; however, the mineworkers take portion sizes well above the standard ratio. A two-weekly menu is arranged and the menu for the current week is included (Table 8.7). One vegetable is served with every meal. This includes a fruit. A protein is served both at breakfast and at the main meal, but not with the food pack. White and brown bread is served every day for breakfast and for the food pack. An average of eight slices is given per mine worker. The bread is spread with hard brick margarine for breakfast and jam or margarine for the shift meal. Approximately 1 litre of milk is served over the week per mine worker. Bread and pap is served every day. Potatoes and rice are served three times a week. No alcohol is served at the kitchen.

Each miner is issued with 250 g of coffee or tea and sugar every month.

8.7.6 Feeding committee

There is a hostel committee but no formal feeding committee. The hostel committee meets every Monday, but only if there are issues concerning the hostel food will the hostel manager be invited to the meeting, which does not happen often. Usually the union representative or individual mineworkers discuss complaints or suggestions with the hostel manager directly. Common complaints are that the bread is a dry, the portions are too small, or the food has no taste.

8.7.7 Health and safety

The kitchen policy is available at head office and copies of the code of conduct were visible around the kitchen and in certain offices. There are monthly safety meetings within the kitchen to report unsafe / unhygienic practices or concerns. A clinic sister accompanies the occupational health and safety committee every month for kitchen inspections. Reports to date have been good. The health of the kitchen staff is checked at the clinic every year. Those who are found to be unfit are given cleaning jobs until they are fit to prepare food.

Table 8.7: The Menu for Hostel Kitchen at the Iron Mine

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Breakfast	Chicken	Russian	Vienna	Wors	Chicken	Russian	vienna
	Egg	Egg	Bread	Bread	Bread	Bread	Bread
	Bread	Bread	Margarine	Margarine	Margarine	Margarine	Margarine
	Margarine	Margarine	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee
	Tea/coffee	Tea/coffee	Mealie meal	Mealie meal	Mealie meal	Mealie meal	Mealie meal
	Mealie meal	Mealie meal					
Main meal	Beef steak	Roast chicken	Steak	Chicken	Mutton stew	Beef stew	Chicken
	Pap	Pap	Pap	Pap	Pap	Pap	Pap
	Mealie rice	Samp and beans	Rice	Mealie rice	Rice	Samp	Rice
	Pumpkin	Cabbage	Roast potatoes	Pumpkin	Mashed potatoes	Cabbage	Roast potatoes
	Salad	Gravy	Gravy	Gravy	Gravy	Salad	Gravy
	Milk	Juice	Jelly & custard	Juice	Milk	Fruit	Jelly & custard
Shift meal	Orange	Apple	Pear	Banana	Orange	Apple	Pear
	Bread	Bread	Bread	Bread	Bread	Bread	Bread
	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
	Jam	Peanut butter	Jam	Peanut butter	Jam	Peanut butter	Jam

Appendix 8.8: Report of hostel kitchen at Platinum Mine

8.8.1 Introduction

At the Platinum Mine two hostel kitchens within the group were assessed and compared; they are Hostel Kitchen 1 and Hostel Kitchen 2. The mine provides the kitchen facilities and personnel. Both hostel managers were interviewed. At both kitchens access to the kitchen is gained by using a card system. By swiping their card, miners have access to the kitchen and are allowed to each as much as they want, although they are restricted to one serving of protein. No food packs are issued at the hostel kitchens. There is no accommodation made for diabetic miners, but they are encouraged to take food that meets their health requirements. The mine runs both kitchens, with no plans to subcontract to a private company.

Table 8.8.1: Number of hostel dwellers and non-hostel dwellers at two shafts at Platinum Mine

	Shaft 1	**Shaft 2**
TOTAL NUMBER IN HOSTELS	992	1 575
TOTAL LIVING OUT	759	1 857
RENT SUBSIDY APPLICATION	40	31

8.8.2 Hostel kitchen meals

Table 8.8.2: Feeding cost, in rand, for hostel dwellers at two different hostel kitchens at Platinum Mine

	Kitchen 1	Kitchen 2
FEEDING COST B/FAST	R1.06	R1.12
FEEDING COST MAIN MEAL	R6.39	R6.09
FEEDING COST P.P.P DAY	R7.45	R7.21
FEEDING COST P.P.P MONTH	R223.50	R216.30
STRENGTH	1 751	3 432

Anglo platinum recommendation = R7.45

A litre of mageu (enriched with protein, vitamins and calcium) is given to each mine worker at the shaft before he goes to work. At each shaft the following sustenance (i.e. Mageu with supplements) was issued in Oct 2002:
At shaft 1: 1 320 packets per day
At shaft 2: 2 352 packets per day

At Kitchen 1

Two meals are provided, namely: breakfast and the main meal. Breakfast is charged to each hostel dweller at R2.00 per meal and the main meal costs the miner R7.45. The official times of the kitchen are as follows:
Breakfast – 04h30 – 07h00
Main meal – 11h00 – 18h00
The number of mine employees staying at the hostel is approximately 998 (excluding contractors). The strength for the morning is 750 and for the main meal is 1 041. The strength is worked out every day. The wastage for Kitchen 1 is 43 g per person for breakfast and 110 g per person for the main meal. The recommended wastage per person is 150 g per person.

At Kitchen 2

The breakfast costs R1.44 and the main meal R6.98. The total deducted from the mine worker is R8.42. The official times at which the kitchen serves meals are 03h00 to 07h00 for breakfast and 10h00 to 18h00 for the main meal. The wastage for Kitchen 2 is 23 g per person for breakfast and 64 g per person for the main meal. The recommended wastage per person is 150 g per person.

8.8.3 Kitchen staff

Food preparation procedures and recipes are the same at both kitchens. A catering officer with an industrial catering background does practical training for all the Platinum Mine hostels. This in-house training includes provision of recipes, cooking basics and hygiene. Medical examinations are performed on all staff at regular intervals. Batch cooking is not done because of limited labour, problems with cooking, and cleaning times.

8.8.4 Kitchen facilities

Mineworkers at Platinum Mine are not allowed to cook in their rooms.

At Kitchen 1

Mineworkers are issued with a steel tray. They are compelled to eat in the dining hall, which has tables and chairs and a TV set. Once they have finished, the mineworkers throw any remaining food into a bin and leave the tray on the counter to be washed.

The shelf life of vegetables is about three days and of meat / chicken is about a week but usually shorter. All food items are clearly marked and items are rotated as they are delivered to ensure that old stock is used before new stock arrives.

At Kitchen 2

Unlike in Kitchen 1, mineworkers in Kitchen 2 provide their own containers and do not have to eat in the dining room. The dining room provided has chairs and tables.

8.8.5 Menu

Table 8.8.5: Portion analysis: Feeding Return for Nov 2002 (for cooked meal)

	Prescribed portion (g)	**At Kitchen 1**	**At Kitchen 2**
B/fast Protein	42	38	33
Bread	170	244	313
Porridge	70	38	47
Spread	30	26	5
Main meal Protein	270	283	273
Beans	30	9	33
Maize Meal	154	147	109
Starch	80	76	93
Vegetables	200	263	189
Salad	30	0	4
Mageu	1 000 ml	715	673

At Kitchen 1

A ration scale was developed for providing food for the mineworkers. The ration scale is followed particularly for meat and, to a lesser extent, for vegetables. The mineworkers may have as much starch as they desire.

Vegetables are serve at every main meal and sometimes as many as two vegetables may be served. Every alternate day a fruit is served, depending on what is in season. A protein of 180 g per person is served at every main meal, and this is in the form of chicken and or red meat. Over the weekends goulash and beef stew is served. The consulting dietician for the group developed the menu.

The dietician is involved with:

- quality control;
- writing up food specifications; and
- monitoring food and nutritional intake.

In addition, she receives "feeding returns" from each hostel, which enables her to calculate an average portion as well as the nutritional intake per hostel.

Bread is served at every breakfast (approximately six slices per person); it is always brown bread. Hard brick margarine is used and the miner has often got the choice of jam or peanut butter to spread on the bread. Milk is not issued to the miners. Tea and coffee are served with breakfast (a mix with sugar, sweetener and a milkblend).

The main meal always has pap and samp, and rice is always served with chicken. The staple foods are pap, samp and bread. Fruit juice is served with the main meal during summer and hot chocolate during winter. Mageu is available during meal times with no limit to the amount taken.

At Kitchen 2

The ration scale was available for providing food to the mineworkers and has been included in this report. It is not followed strictly, except for meat (only one serving allowed) and vegetables. Again, miners may have as much carbohydrate as they want.

Fruit is served twice a week and vegetables once a day. Protein is served at breakfast and the main meal. Bread with margarine is served at breakfast only. Tea and coffee is served every day for breakfast. Pap and samp and beans are served every day. Potatoes are served once a week. Rice and mealie rice are served twice a week. Cooldrink and soup are served alternately. Magou is available during meal times with no limit to amount taken.

An interesting difference in this menu is that two proteins are offered in the main meal, thus resulting in a saving for the kitchen.

It is not fair to compare the kitchens in terms of prices and menus because often the people staying in the hostel make up the menus, and the menus, thus, differ at each kitchen. What will work in one kitchen may not necessarily work in another was a comment made by the hostel manager.

8.8.6 Feeding committee

At Kitchen 1

There is a feeding committee made up of the hostel manager, seven union representatives from NUM, UMDWA and Mouth Piece as well as two mineworkers staying at the hostel who are not affiliated to any union group. The feeding committee meets twice a week. The hostel manager has an open-door policy where any concerns can be addressed at any time.

At Kitchen 2

There is a feeding committee, which is made up of union members (Mouth Piece, NUM and UDMWA), hostel dwellers, the hostel manager, the kitchen administer as well as the three shift supervisors. Complaints include shortage of food, poor food quality, and a very high bone content in the meat. All complaints are documented and addressed.

8.8.7 Health and safety

No food policy procedures or policies were available. Health and safety audits are carried out at the kitchen.

Table 8.8.7.1: Menu at Kitchen 1 at Platinum Mine

MEAL PLAN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
WEEK 1							
BREAKFAST							
PORRIDGE	Lambalazi	Sebube	Mabela	Lambalazi	Sebube	Mabela	Lambalazi
BREAD	Brown	Brown	Brown	Brown	Brown	Brown	Brown
MARGARINE	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
SPREAD	Jam	Jam	Jam	Jam	Jam	Jam	Jam
BEVERAGE	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee
PROTEIN	Chicken stew	Beans	Liquid eggs		Dry stew		
MAIN MEAL							
SOUP	Oxtail	Chicken	Vegetable	Tomato	Beef & onion	Chilli chow	Beef
MAIZE MEAL	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge
PROTEIN	Beef Port	Chicken	Beef stew	Chicken	Beef stew	Beef stew	Chicken
STARCH	Rice	Beans	Samp	Samp & Beans	Rice	Maize rice	Samp
VEG NO. 1	Pumpkin	Mash potatoes	Cabbage & potatoes	Sweet potatoes	Carrots	Cabbage	Spinach & Potato
VEG NO. 2	Tomato	Green (coleslaw)	Carrots	Cabbage	Potato	Carrot	Beetroot
MAGEU	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
BEVERAGE		Cool drink		Cool drink			
FRUIT			Fruit				
DESSERT							Jelly & custard
WEEK 1							
BREAKFAST							
PORRIDGE	Lambalazi	Sebube	Mabela	Lambalazi	Sebube	Mabela	Lambalazi
BREAD	Brown	Brown	Brown	Brown	Brown	Brown	Brown
MARGARINE	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
SPREAD	Jam	Jam	Jam	Jam	Jam	Jam	Jam
BEVERAGE	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee
PROTEIN	Chicken stew	Beans	Liquid eggs		Dry stew		
MAIN MEAL							
SOUP	Oxtail	Chicken	Vegetable	Tomato	Beef & onion	Chilli chow	Beef
MAIZE MEAL	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge
PROTEIN	Beef Port	Chicken	Beef stew	Chicken	Beef stew	Beef stew	Chicken
STARCH	Rice	Beans	Samp	Samp & Beans	Rice	Maize rice	Samp
VEG NO. 1	Pumpkin	Mash potatoes	Cabbage & potatoes	Sweet potatoes	Carrots	Cabbage	Spinach & Potato
VEG NO. 2	Tomato	Green (coleslaw)	Carrots	Cabbage	Potato	Carrot	Beetroot
MAGEU	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
BEVERAGE		Cool drink		Cool drink			
FRUIT			Fruit				
DESSERT							Jelly & custard

Table 8.8.7.1: Menu at Kitchen 1 at Platinum Mine (continue)

WEEK 3							
MEAL PLAN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
BREAKFAST							
PORRIDGE	Lambalazi	Sebube	Mabela	Lambalazi	Sebube	Mabela	Lambalazi
BREAD	Brown	Brown	Brown	Brown	Brown	Brown	Brown
MARGARINE	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
SPREAD	Jam	Jam	Jam	Jam	Jam	Jam	Jam
BEVERAGE	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee
PROTEIN	Mauso food/ stew	Liquid egg	Chicken stew	Dry stew	Whole egg		
MAIN MEAL							
SOUP	Beef	Chilli chow	Oxtail	Chicken	Tomato	Vegetable	Beef
MAIZE MEAL	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge
PROTEIN	Beef	Chicken	Beef	Chicken	Beef stew	Beef / Chicken	
STARCH	Samp	Samp & Beans	Rice	Maize Rice	Pasta	Rice	Samp
VEG NO. 1	Carrots & Potatoes	Cabbage	Potatoes	Carrot	Sweet potatoes	spinach	Pumpkin
VEG NO. 2	Pasta salad	Tomato	Coleslaw	Potato salad	Cabbage	Beetroot	Cabbage
MAGEU	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
BEVERAGE		Cool drink		Cool drink			
FRUIT			Fruit				
DESSERT							Jelly & custard
Week 4							
BREAKFAST							
PORRIDGE	Lambalazi	Sebube	Mabela	Lambalazi	Sebube	Mabela	Lambalazi
BREAD	Brown	Brown	Brown	Brown	Brown	Brown	Brown
MARGARINE	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Margarine
SPREAD	Jam	Jam	Jam	Jam	Jam	Jam	Jam
BEVERAGE	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee	Coffee
PROTEIN	food/ stew	Liquid egg	Chicken stew	Dry stew	Whole egg		
MAIN MEAL							
SOUP	Beef	Chilli chow	Oxtail	Chicken	Tomato	Vegetable	Beef
MAIZE MEAL	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge	Maize porridge
PROTEIN	Beef	Chicken	Beef	Chicken	Beef stew	Beef / Chicken	
STARCH	Samp	Samp & Beans	Rice	Maize Rice	Pasta	Rice	Samp
VEG NO. 1	Carrots & Potatoes	Cabbage	Potatoes	Carrot	Sweet potatoes	spinach	Pumpkin
VEG NO. 2	Pasta salad	Tomato	Coleslaw	Potato salad	Cabbage	Beetroot	Cabbage
MAGEU	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
BEVERAGE		Cool drink		Cool drink			
FRUIT			Fruit				
DESSERT							Jelly & custard

Table 8.8.7.2: Menu at Kitchen 2 at Platinum Mine

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
BREAKFAST						
Mince	Noodle	Liquid eggs	Meat loaf	Mince	stew	Porridge
Porridge	Lambalazi	Sebube	Porridge	Lambalazi	Sebube	Bread
Bread	Bread	Bread	Bread	Bread	Bread	Margarine
Margarine	Margarine	Margarine	Margarine	Margarine	Margarine	Jam
coffee	tea	Coffee	tea	coffee	tea	cocoa
MAIN MEAL						
Chicken	Beef	Chicken	Beef	Beef	Beef	Chicken
Mince	Chicken	Wors	Chicken	Mince	Chicken	Wors
Salt	Salt	Salt	Salt	Salt	Salt	Salt
Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
Samp/beans	Samp & beans	Samp & beans	Samp & beans	Samp & beans	Samp & beans	Samp & beans
Rice		Maize rice		Rice	Mealie rice	Sweet potato
Mixed vegetable	Pumpkin	Cabbage		Mash potato	Spinach	Jelly & custard
Soup	Cool drink	Soup	Cool drink	Soup	Coleslaw	Beetroot
mageu	mageu	Mageu	mageu	mageu	mageu	mageu
		Fruit		fruit	Cool drink	soup

Appendix 8.9: Report of hostel kitchen at Coal Mine 1

8.9.1 Introduction

The hostel kitchen at the Coal Mine has been subcontracted since 1998. The kitchen manager was interviewed. The kitchen is open to all employees (hostel and non-hostel dwellers) and their families; however, they have to be 'logged on' to the system. To obtain food they have to present identification; their industry card is 'swiped through' for each meal they consume, and the cost of the meal debited off their salary. They may eat as much as they like and may present themselves for a meal as often as they want to but for each protein they eat they are charged for another meal. There are about 364 mineworkers staying in the hostels and 1 145 mineworkers living out.

8.9.2 Hostel kitchen meals

The kitchen provides two meals: namely, breakfast and the main meal. No food packs for mid-shift feeding are arranged. The employees at the mine are charged R2.88 for breakfast and R6.75 for the main meal. The number of meals served during breakfast averages around 224 and for lunch around 702. The hostel manager is unable to give the percentage of mineworkers living out that eat at the kitchen.

The opening times are from 22h00 to 09h00 for breakfast and 13h00 to 20h00 for the main meal. No food packs are available. Wastage is kept to a minimum because leftover food is often served at the next meal. Since not all mineworkers eat at the dining hall, it is difficult to monitor the wastage from food not consumed by the mineworkers.

8.9.3 Kitchen staff

The kitchen staff is made up of three shifts with five workers and a supervisor at each shift. At each shift there are two cooks. Batch cooking is used so that by midday 60% of the cooking for the main meal is complete and at 16h30 the staff can decide how much more needs to be cooked for those arriving after 17h00. This is usually around 15%. On an average day the staff can cook up to three meals. The advantage is that there is very little wastage. If anything remains from the main meal it is served for breakfast the next day.

The staff all received training through the subcontractor when they started. Follow-up training occurs on an *ad hoc* basis.

8.9.4 Kitchen facilities

Mineworkers have their own containers. A dining room is available with a TV set; however, many take their food to their rooms. Cooking in the rooms is prohibited. The subcontractor also has a tuck shop, which is also used by the mineworkers extensively. Fried chips and fish as well as burgers, Russians, chips, toasted sandwiches, cool drinks and sweets are available. Approximately 80% of employees living outside the hostels make use of the tuck shop, which includes those staying in married quarters because they are not keen to cook themselves.

Good stock taking and control was evident. The kitchen facilities, however, were not as clean and as organised as other kitchens were. Some of the stock was rotten but an assurance was given that it would not be served and that this did not occur often.

8.9.5 Menu

The kitchen does have a ration scale. This scale is applied before the food is cooked.

TABLE 8.9.5.1: Portion sizes of meals served at Coal Mine 1

MENU	SPEC (g)
Beef stew	0.300
Chicken	0.300
Beef sliced	0.300
Pap	0.150
Soup	0.015
Vegetable	0.75
Salad	0.075
Rice	0.075

The Coal Mine does not follow a set menu but the menu below serves as an example of a typical week. Vegetables served depend on availability and cost. For example, potatoes had gone up to R28/10kg and were, therefore, replaced with carrots and pumpkin for the week. Similarly, eggs served for breakfast may be substituted with chicken giblets or viennas.

A vegetable is served with every main meal. What vegetable is served depends on availability and cost. Usually potatoes, pumpkin, cabbage, carrots and spinach are served. Fruit is served with the main meal on Saturdays and Sundays. A protein is served at breakfast and at the main meal. Brown bread is served for breakfast with margarine and an option of peanut butter or

jam. Milk was offered for breakfast but the premixed coffee and tea is much more popular. One litre of Mageu is issued per miner with his main meal; in summer this is replaced with cooldrink.

TABLE 8.9.5.2: Menu at hostel kitchen at Coal Mine 1

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
BREAKFAST				
Cheese and egg	Polony	Hamburger patties	Mince	Chicken giblets
Bread	Bread	Bread	Bread	Bread
Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee	Tea/coffee
MAIN MEAL				
Beef sliced	Chicken	Beef sliced	Chicken	Beef slices
Pap	Pap	Pap	Pap	Pap
Soup	Soup	Soup	Soup	Soup
Vegetable	Vegetable	Vegetable	Vegetable	Vegetable
Salad	Salad	Salad	Salad	Salad
Rice	Rice	Rice	Rice	Rice
Wors	Stewing beef	Wors	Kidney	Liver
Mageu	Mageu	Mageu	Mageu	Mageu

Pap is served every day. Potatoes were served once a week but are no longer served as they have become too expensive. Rice is served every five days. On Sundays, jelly and custard is served.

The kitchen manager had obtained the menu from a mine in Phalaborwa. There was no dietician for the kitchen to consult.

8.9.6 Feeding committee

There is a feeding committee made up of the unions (NUM and MUWSO) as well as hostel dwellers. At 11h30 every day an elected member of the feeding committee tastes the food before it is served to the miners at 12h00. If there is anything he is concerned about it is not served and the kitchen supervisor is informed of any complaints.

8.9.7 Health and safety

The risk assessment team does a health and safety audit of the kitchens every few months. The team includes an occupational health sister form the clinic. Swabs are taken and general health and safety issues are addressed. If there is an incident of diarrhoea at the clinic then the audit is done as soon as possible to exclude any possibility that the hostel kitchen was at fault. There are no kitchen policy or procedures.

Appendix 8.10: Report of hostel kitchen at Gold Mine 1

8.10.1 Introduction

The hostel manager and a member of the Hostel Residence Committee and the Catering Superintendent accompanied the Miningtek staff member on the visit to the hostel kitchen. The mine provides the kitchen facilities and personnel.

Approximately 7 000 workers use the kitchen and dining room facilities. Mineworkers staying in the hostels have access to these facilities; those staying outside or who have families staying in the family quarters are not catered for. Diabetics are catered for with raw ingredients. Since mineworkers are allowed to prepare food in the hostels, this is a very feasible option.

Workers share rooms and a programme to upgrade the hostel room is in progress. Recreational facilities provided include a central lounge, recreational facilities, TV rooms, disco rooms and a stand for bands to provide “live” performances. A large variety of sports facilities are also available in close proximity to the residence. Toilets to accommodate females visiting the hostel are also being provided.

8.10.2 Hostel kitchen meals

The kitchen serves two meals: namely, breakfast and the main meal. No food packs are issued. The kitchen opens at 03h00 and breakfast is served till 09h00. After 09h00, mineworkers can still get six slices of bread and as much mate Bella as they want. The main meal is served from 11h00 to 24h00. Batch cooking is done by cooking two thirds of the meal before lunch and the last third in the afternoon. No lunch pack is provided for mid-shift feeding.

The average daily strength for breakfast is 4 975 and for lunch it is 5 981. The meal costs the mine worker R7. 00 per day: R2. 20 for breakfast and R4. 80 for the main meal. The main meal is only charged for if the mine worker takes a protein, and no other protein may be taken until the next meal. He is, however, allowed eat as much as he likes. Wastage control also plays an important role and is used by the food service manager to establish whether the chefs serve too much food, whether the food is wrongly prepared, or whether the food is of a poor quality. Food wastage is a concern, with the main content of waste being bread, at approximately 6-10 drums per day. There is a pig farmer that collects the wastage every morning. The food service manager also updates all the recipes at present and teaches the kitchen employees on a continuous basis.

8.10.3 Kitchen staff

There is a total of 60 chefs / kitchen staff; 20 per shift; three shifts per day. All the chefs are trained (National Qualification framework (NQF) qualifications). The food service manager has a technikon degree, and is responsible for recipes, food preparation techniques and the training of the staff.

8.10.4 Kitchen facilities

The dining room of the residence has recently been upgraded and cubicles have been constructed in the dining hall. An atrium, with pot plants, forms part of the dining hall. This arrangement, which creates an atmosphere of privacy and cosiness, has been well accepted by the workers who use this facility. Tiles are used extensively on the floors as well as on the walls of the cubicles. Decorative tiles are also used on these walls. Mineworkers provide their own eating utensils. Good stock taking and control were seen to take place. The kitchen was clean but the serving area did get messy at times.

According to the hostel manager, approximately 80% of the residents get their meals from the kitchen. Workers can also prepare their own meals in their rooms, where the mine provides two-plate stoves. Small “shops”, run by workers in their spare time, provide groceries, fruit and vegetables that are used as ingredients for meals prepared in the rooms.

8.10.5 Menu

The menus used were developed and compiled by dieticians at the regional hospital. The breakfast generally consists of a meat portion (mini polony, soup, meat loaf, and chicken stew), lambalazi, brown bread, tea/coffee and mageu. The workers pour the mageu in plastic containers and many of them then take it underground for mid-shift feeding. Approximately 2 500 litres of mageu is consumed every day. No official lunch packet is provided for mid-shift feeding. The issue of mid-shift feeding will be taken up with management in the near future. The main meal is generally well balanced, and lambalazi, porridge, samp and rice forms part of each meal to accommodate the preferences of various groupings. A vegetable is served with every main meal (100 g) and vegetables include spinach, pumpkin, butternut, cabbage, sweet potatoes, potatoes, and beetroot. Peas are not used often as they are difficult to obtain. Brown bead is offered every day and white bread is offered on Sundays and the mineworkers can spread margarine, jam or peanut butter on their bread. Amasi is served on Fridays (500 ml) and sorghum beer on Wednesday. Lambalazi, bread and pap are served everyday, and rice is served twice a day.

There is no ration scale for the menu, except for protein (only one item of either 205 g of chicken or 240 g of beef), bread (six slices) and fruit (only one item allowed).

The current menu is being updated by the food service manager at present and will be negotiated with the management of the mine in the future. She has a degree in food service management, is responsible with the equality control at the kitchen and stores and stocks are well organised to ensure that all products are used before the expiry dates. She also checks on the quality of the meat received.

Some of her concerns are that the cabbage ordered is white, which has little nutritional value (but is a firm favourite with the mineworkers). The suppliers leave the vegetables out for a day or two before delivering them, often in vans that have no refrigeration. This results in the vegetables being less fresh and nutritious. Fruit is also third grade, which she is not happy about. As for the meat, the ratio of bone to meat is high because most of the pieces are cut from the leg of the cow, which works out to be cost effective for the suppliers. Her suggestions are that those running the kitchen should have a say in what food is used, which is not the case at present. Usually the mining stores decide on their orders and often go for the cheapest items. A good example is the bread, which was the major source of wastage, has recently been replaced by a more expensive brand. Because this bread does not crumble, the mineworkers think it is of a better quality and are now eating the bread.

8.10.6 Feeding committee

The hostel residence committee consists of 13 members and they meet at least once a week to discuss issues, which include the quality of the meals as well as complaints from residents in this regard. The Hostel Manager and Catering Superintendent attend to any problems regarding the kitchen and meals.

According to one of the members of the residence committee, workers seldom complain about the quality of their meals and, when there is a complaint, it is usually dealt with immediately by management of the kitchen.

8.10.7 Health and safety

There is no formal kitchen policy or procedure at this kitchen. A health inspector inspects the kitchen four times a week with the food service manger and ensures that everything is healthy and hygienic as well as safe.

TABLE 8.10: Menu served at the hostel kitchen at Gold Mine 1

MON	TUES	WED	THUR	FRI	SAT	SUN
BREAKFAST						
Beef stew	Hamburger patties	Polony	Boiled eggs	Amasi	Jam	Peanut butter
Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi
Brown bread	Brown bread	Brown bread	Brown bread	Brown bread	Brown bread	Brown bread
Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
Tea			Tea			Tea
MAIN MEAL						
Roasted chicken	Bone in stew					
Chicken soup	Beef soup					
Hard porridge	Hard porridge	Hard porridge	Hard porridge	Hard porridge	Hard porridge	Hard porridge
Samp	Samp	Samp	Samp	Samp	Samp	Samp
Beans	Beans	Beans	Beans	Beans	Beans	Beans
Spinach	Stir-fry cabbage	Mashed potatoes	Glazed carrots	Boiled cabbage	Sweet potatoes	Carrot and potato pot
Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi	Lambalazi
	Rice					
	Fruit					
	Cool drink		Cool drink			Sorghum beer
		Sorghum beer				Jelly and custard

Appendix 8.11: Report of hostel kitchen at Gold Mine 2

8.11.1 Introduction

The hostel kitchen manager accompanied the Miningtek staff member on the visit to hostel kitchen. The mine provides the kitchen facilities and personnel. The kitchen provides three meals per day to the 4 000 mineworkers staying at the hostel only. Diabetics are catered for and receive snack packs, which are issued every day.

8.11.2 Hostel kitchen meals

The mine provides three meals: namely, breakfast, main meal and supper. Food packs are not provided. Mageu is available 24 hours a day on tap outside the hostel kitchen. A ration scale for providing food to the mineworkers is followed strictly and mineworkers are not allowed to have "seconds", as is common practice at other hostel kitchens. Mineworkers swipe their cards in order to receive their food. The total cost for all three meals is R5.50. The strength for breakfast is 2 816; for lunch it is 3 780 and for supper it is 1 020.

Wastage is also monitored. On average two drums (205 litres) of food is wasted per day and used by the local pig farmers.

8.11.3. Kitchen staff

The kitchen has 78 staff members. There are nine staff members at each shift and there are four shifts. An outside company in Johannesburg has trained some of the kitchen staff. The kitchen supervisor is concerned about the training received and in some cases the lack of training. Many of the kitchen staff is underground mineworkers that were transferred to the surface after having suffered an injury. This, however, has not happened since 1993. There are no recipes available for the kitchen staff. The staff does batch cooking. Half of the cooking is started at 07h00 and the other half at 11h00.

8.11.4 Kitchen facilities

The mine provides trays for miners to collect their food, and provides them with a dining hall, which has chairs and tables. Mineworkers are not allowed to remove food from the dining hall, and the trays are handed in for washing before the mineworkers leave. The only food the mine worker is allowed to leave with is the bread he receives in the morning and mageu, which is available outside the kitchen. Mineworkers are not allowed to eat or cook in their rooms;

therefore, all food is served and eaten at the dining hall. Of all the kitchens observed, this was the cleanest kitchen. Most of the stock was issued and used the same day, with only dry ingredients being stored.

8.11.5 Menu

Breakfast is served form 03h00 to 08h00. The menu is as follows: lambalazi (white and brown), brown bread (six slices – 40% are buttered), coffee/tea (premix) and either pasta and mince; boiled eggs; mince and rice, or amasi. Lunch is served form 11h00 to 18h00. Lunch consists of a protein (Roast chicken – 215 g or Russian; stewing beef – 235 g or braised steak – 235 g), a gravy or soup; samp with or without beans; mealie pap (brown or white); and 100 g of a vegetable (either cabbage, mashed potatoes, cabbage mix, spinach mix, carrot mix, pumpkin or mixed vegetables). Cool drink and mageu is also served during the meal. Supper is served from 18h30 to 20h00. Supper consists of mealie pap and bean stew or chicken/mince/meat and vegetable stew or ox tripe. If the shift is late, the kitchen is informed so that when the miners come back from the shift, there is food available for them after 'official hours'. No lunch pack is provided for mid-shift feeding. A fruit (in season) is served once a week and fruit salad twice a week. Amasi is served every Sunday with breakfast (800 ml).

A dietician that was employed in the past probably developed the current menu. A consulting dietician has done a nutrition analysis of the menu recently. All products are used before their expiry dates. All products issued are labelled with the date received and the products are inspected to determine the quality of the products. In general, bread, vegetables and meat are ordered the day before and consumed the next day. Vegetables are not frozen.

8.11.6 Feeding committee

The residence committee consists of union representatives, senators and management as well as representatives from the residences. They meet once a month. If there are any concerns, mineworkers are encouraged to lay a complaint with any of committee representatives. Problems are sorted out as soon as possible and are only referred to the monthly committee meetings if the members of the committee have not been able to resolve them. One of the concerns that have been brought up is the shortage of food at lunchtime, especially of meat. This has been resolved by not over issuing meat to early comers to the meal. Another concern expressed by mineworkers is that access is often denied when they swipe their cards. This occurs when the computer system incorrectly assumes that the mine worker is on holiday and therefore denies the mine worker access to the kitchen. A further concern it that there has been bad behaviour from drunk mineworkers demanding food in the past.

8.11.7 Health and safety

The occupational hygiene department does a monthly audit of the kitchen. The kitchen staff has a comprehensive hygiene and safety checklist. For the month of November, the kitchen received a good report of high standards in the kitchen and dining room, with no issues or problems noted.

All kitchen staff members are sent every 12 months for a medical examination as part of their medical surveillance. Every morning staff meet for 10 minutes to discuss safety or health concerns in the kitchen.

TABLE 8.11: Menu of hostel kitchen at Gold Mine 2

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY8
BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST
Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)	Lamabalazi (W)
Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)	Lamabalazi (B)
Brown bread	Brown bread	Brown bread	Brown bread	Brown bread	Brown bread	Brown bread	Brown bread
Sandwiches	Sandwiches	Sandwiches	Sandwiches	Sandwiches	Sandwiches	Sandwiches	Sandwiches
Pasta and mince	Boiled eggs	Mince and rice	Pasta and mince	Mince and rice	Amasi	Pasta and mince	Mince and rice
Coffee (unipack)	Tea (Rooibos)	Coffee (unipack)	Tea (Rooibos)	Coffee (unipack)	Tea (Rooibos)	Coffee (unipack)	Tea (Rooibos)
LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
Shebo Mexican roast chicken	Beef and onion soup	Curry veg soup	Beef and onion soup	Chicken gravy/ Roast chicken	Savoury thickener	Shebo Mexican	Beef and onion soup
Russian	Stewing beef	K F Chicken	Braised steak	Russian	Stewing beef	K F Chicken	Braised steak
samp	Beans & samp	Beans	Samp	Peas	Rice	Samp	Beans and samp
Cabbage	Mashed potatoes	Cabbage Mix	Spinach Mix	Braised Cabbage	Pumpkin	Mixed veg	Carrot mix
Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge
Fruit salad				Fruit salad			
Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu	Mageu
Cold drink	Cold drink	Cold drink	Cold drink	Cold drink	Cold drink	Cold drink	Cold drink
SUPPER	SUPPER	SUPPER	SUPPER	SUPPER	SUPPER	SUPPER	SUPPER
Bean Stew	Chicken & Veg stew	Mince and veg stew	Ox tripe	Chicken and Veg stew	Bean Stew	Beef and Veg stew	Ox tripe
Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge	Porridge

Appendix 8.12: Report at Coal Mine 2

By October 2000, Coal Mine 2 had converted all the hostel rooms into flats and there is no longer a hostel kitchen. In the 1980s the mine was responsible for the food and accommodation. Then in the 1990s three private kitchens were brought in to run the hostel kitchen. Reef Food lasted three years, then another subcontractor about six months, and then the last group introduced a system where mineworkers could buy their food from them, but this group only lasted six months. The main problem was the quality of the food, and the hostel dwellers were happier to cook for themselves and have facilities to accommodate wives and girlfriends that could cook for them.

Of the 760 Coal Mine 2 employees, 450 stayed in the hostels. A study was done on all hostel dwellers before and after the introduction of the living out allowance in 2000. Below (Figure 8.12.1) is a BMI average of all hostel dwellers in 1999 and in 2000.

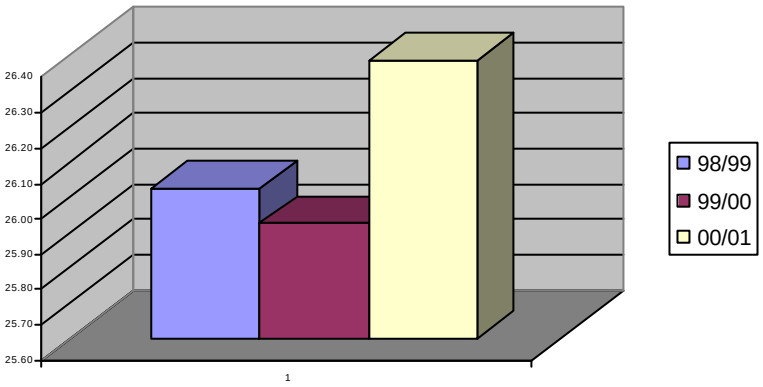

Figure 8.12.1: Average BMI of Hostel dwellers from 1998-2001

Appendix 8.13. Food storage

Microorganisms (germs) are easily spread, and tolerate extreme conditions; they are everywhere and may contaminate and grow in many food products. The behaviour of microorganisms in foods (growth, survival, or death) is determined by the properties of the food (e.g., water activity and pH) and storage conditions (e.g., temperature, relative humidity, and atmosphere) **(McMeekin TA et al, 1997)**. Bacteria grow between 7°C and 63°C. Ambient temperatures underground can be 26-36°C, which is therefore not suitable for keeping fruit or any other food fresh. Food should be kept at temperatures, which, are safe and do not allow microorganisms to grow. Food not kept at the correct temperature contributes to food poisoning (**McMeekin TA et al., 1997)**. Annexure D, Regulation 8(4) of R918, under the Health Act (Act 63 of 1977) states:

Category	Type of food	Required core temperature of food products that are stored, transported or displayed for sale
Frozen products	Ice cream and Sorbet	**-18?C**
	An other food which is marketed as a frozen product	**-12?C**
Chilled products	Raw unpreserved fish, molluscs, offal, poultry, meat and milk	**+4?C**
	Any other perishable food that must be kept chilled to prevent spoilage	**+7?C**
Heated products	Any perishable food not kept frozen or chilled	**>/+65?C**

Appendix 8.14: Example of food specification record

<table>
<tr><td colspan="4">Mine company</td></tr>
<tr><td colspan="2">Specification
Number</td><td colspan="2">Food commodity specification
Reference:</td></tr>
<tr><td colspan="2">AMC code
No.:</td><td colspan="2">Date:
Amended:</td></tr>
<tr><td colspan="4">Product name:</td></tr>
<tr><td colspan="4">Definition:</td></tr>
<tr><td colspan="4">Shelf life and storage requirements:</td></tr>
<tr><td>Product ingredients:</td><td>Source:</td><td>Nutritional analysis per 100g:
Protein
Energy
Starches
Sodium
Calcium
Fat soluble vitamins</td><td>Source</td></tr>
<tr><td>Chemical analysis:
Total solids content
Alcohol content
Moisture</td><td>Source</td><td>Microbiological/bacteriological requirements:</td><td>Source</td></tr>
<tr><td colspan="4">Packaging and labelling:</td></tr>
<tr><td colspan="4">General:</td></tr>
<tr><td colspan="4">Transport and Delivery:</td></tr>
</table>