

# CHAPTER 6 – GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

## 6.1. INTRODUCTION

This final chapter provides a summary of the main findings of the three articles that form part of this thesis and draws conclusions based on these findings. The results have already been discussed, interpreted and compared with the relevant literature in Chapters 3, 4 and 5. Recommendations for future research are also made. The main findings and conclusions drawn are aimed at addressing the objectives of this study. For ease of reference, the main aim and objectives are repeated below, followed by the general discussion and conclusion.

### **Aims and objectives**

The main aim of this project was to determine the association between dietary intake and CVD risk in black South Africans in the context of urbanisation.

### **The objectives of this study were to:**

- Investigate the aetiology of CAD in black South Africans.
- Evaluate the dietary habits of rural and urban black South Africans by:
  - using nutrient and food group intakes as well as diet quality scores,
  - evaluating the use of predefined diet quality scores in a black African population in transition,
  - determining the role of diet in CVD risk in the context of urbanisation.
- Investigate the role of diet in diagnosed CAD in the context of urbanisation, using nutrient and food group intakes.

## 6.2. THE AETIOLOGY OF CAD IN BLACK SOUTH AFRICANS

Owing to the historically rare incidence of CAD in black South Africans, there is not the same wealth of information available on this topic for black South Africans as there is for the general Caucasian population. As has been postulated for years, the transition to a more Westernised lifestyle has been accompanied by an increase in risk factors for CVD, as well

as an increase in incidence of CHD, although this increase in incidence is not yet as marked as was expected or predicted (Sliwa *et al.* 2008; Walker *et al.* 2004). Our case-control study revealed that the black South African CAD patients presented with the same risk factors as are typically seen in Caucasians. A logistic regression revealed that small dense LDL and insulin resistance were the main predictors of CAD in this population. The fact that the subjects were matched for age and body composition, and that overt diabetes was excluded, meant that it was possible to determine the independent contribution of insulin resistance among the other components of the metabolic syndrome.

As with most research topics, the questions pertaining to the topic evolve as more evidence is added to the body of evidence. Previously, some known risk factors were thought to be absent or not considered major contributors to risk in this population; for example, black South Africans were known to have a favourable lipid profile, a form of obesity for which the term “healthy obesity” was coined, as well as low levels of the fibrinolysis inhibitor PAI-1 (Pieters & Vorster, 2008; Walker *et al.* 1989; Walker *et al.* 1990). The picture has changed, however, as this population continues with the transition process, and increased lipid levels, for example, are no longer uncommon. It now seems that, whereas it was previously thought that CVD was uncommon in this population because of possible protective factors, this generation now has a high prevalence of, and exposure to, risk factors such as hypertension, diabetes and obesity as a consequence of urbanisation, culminating in the appearance of CVD events. There does seem to be a difference in the type of CVD event compared with Caucasians, with a higher prevalence of stroke and hypertensive heart disease than CAD in this population (Mayosi *et al.* 2009; Stewart *et al.* 2011). The exact contribution of the individual risk factors in black South Africans needs to be elucidated and, once this is understood, the application of stricter or more appropriate cut-off points for medical intervention could help to target prevention in this population. Hypertension, for example, is highly prevalent in the black South African population and appears to be more severe than in the Caucasian population, with various environmental and genetic factors playing a causal role in this phenomenon. Various differences between black and Caucasian South Africans in hypertension-related parameters and genetic mutations have been documented, including the fact that black South Africans are considered to be more salt-sensitive than Caucasians (Lindhorst *et al.* 2007; Seedat, 2000). Hypertension cut-off values for treatment should therefore be investigated and treatment or intervention should possibly be aimed at a lower of cut-off than in Caucasians.

Obesity is another risk factor for which some evidence exists of ethnic differences, particularly in black women. It has been seen that for the same waist circumference, African American women have less visceral fat than Caucasian women (Conway *et al.* 1995), visceral fat being known to increase the risk for CAD more than adiposity *per se*. A cut-off point of 90cm for black South African men (compared with the current 94cm) and a female cut-off of 98cm (compared with the existing 80cm) have been suggested when analysing the components of metabolic syndrome (Prinsloo *et al.* 2011). Although this needs to be confirmed in a larger sample group, it is an example of the type of information that will help to address CVD in a way that is more ethnicity-specific.

The literature review (Chapter 2) highlighted the potential role played in the development of CAD in the black population by hypertension, DM, dyslipidaemia, obesity, inflammation (hs-CRP), fibrinogen, physical activity, stress and a low fruit and vegetable intake. Although many of the same risk factors are seen in the black South African population as are reported in Caucasians, and current programmes and guidelines aimed at prevention of CVD in the general population will be of benefit, there does appear to be some scope for tailor-making and adjusting prevention strategies for this black South African population, by understanding the individual contributions to this population of these known risk factors. This approach is similar to what has been used by European Risk assessment scores such as the SCORE, QRISK1 and QRISK2, which have developed different scores for population groups that are known to be at high or low risk for CVD, where cut-off values for risk factors known to be prevalent or “contributing factors” in those populations are adjusted accordingly in order to aid earlier identification and intervention (Conroy *et al.* 2003; Hippisley-Cox *et al.* 2007; Hippisley-Cox *et al.* 2008). This would be ideal for the South African population, in which people of various ethnicities and/or socio-economic backgrounds are known to have varying degrees of CVD risk.

### **6.3. DIETARY HABITS OF RURAL AND URBAN BLACK SOUTH AFRICANS**

The dietary changes associated with urbanisation have been well documented in developing countries (MacIntyre *et al.* 2002; Popkin, 1998), yet evaluating the dietary intake of this population raised some interesting points. The urban group consumed significantly higher amounts of all nutrients and foods, except for carbohydrate as percentage energy. The urban group, therefore, consumed more nutrients and foods considered “protective” as well as those considered “harmful” within the context of CVD risk. The traditional expectation would have been that the rural group would consume more “protective” foods, such as high

fibre, more fruit and vegetables, as well as having lower fat intakes, when in fact they had a lower intake of all foods and nutrients. What should be noted, however, is that although the urban group had higher intakes than the rural group, they nevertheless consumed a diet that is considered to be low in fat (when compared with current dietary guidelines for prevention of CVD), but also a diet low in fibre, fruit and vegetables and micronutrients.

Despite a dietary intake that is still within prudent guidelines, the urban group, particularly the women, did have an increased CVD risk. The low fruit and vegetable intake, and therefore, low micronutrient intake (“hidden hunger”) is of concern and possibly plays an important role in the (lack of) protection against CVD (Burchi *et al.* 2011). The National Food Fortification Programme initiated by the South African Department of Health has resulted in staple foods such as maize meal and bread being fortified with vitamin A, thiamine, riboflavin, niacin, pyridoxine, folic acid, iron and zinc, possibly explaining the higher intakes of these nutrients; however, this study highlights the problem of the rural population’s continued vulnerability in terms of dietary intake. A contributing factor to the “hidden hunger” problem is the disconcertingly low intake of fruit and vegetables. In the urban group, the intake was less than half of the recommended intake of 400g per day, and the rural group’s intake was less than half of that of the urban group. Fruit and vegetables are a major contributor to the intake of fibre and a large variety of micronutrients.

The approach to the assessment of dietary intake has seen a shift over the last few decades, moving from mostly quantitative to more qualitative approaches, which is considered to be more holistic. This approach, which uses dietary patterns, takes into account the complexity of dietary behaviours, and for the purpose of this thesis, theoretically defined diet quality scores were used to assess dietary intake. There are, however, no available predefined DQS that have been developed for non-Western developing populations. The two existing DQS used in this thesis were carefully selected, based on relevant literature and adapted as far as possible for the study population. As the title of this thesis indicates, the protective and harmful aspects of dietary intake in relation to CVD risk were explored by selecting the Thiele score (Thiele *et al.* 2004), which consisted of two scores, namely the “deficient” and “excess” scores, and the HDI score (Huijbregts *et al.* 1997), which assesses diet quality in relation to proven dietary guidelines for the prevention of CVD.

In agreement with the results of the nutrient intakes, both DQS showed that the urban groups (men and women) had a better diet quality than their rural counterparts. However, when looking at the score totals in isolation, an inaccurate picture may be created. When analysing the individual components or concepts that make up the scores, it is clear that these scores cannot be applied in a straightforward way in this population with a low fat and

micronutrient intake. By additionally looking at the percentage of the population that did not meet the EAR/AI, a different picture emerged. Although the urban group consumed a much higher fat intake than did the rural group, it was still within the guidelines for prevention of CVD, which were used as cut-offs in the DQS. Because of this generally low fat intake, scores in the urban group were consequently not “penalised” for having a higher fat intake than the rural group. This implies that in populations with low micronutrient and fat intakes, cut-off values and weighting within scores need to be carefully constructed to take these unique issues into account. Another issue that was encountered was how to interpret the total score in terms of good or poor quality. In the rural group, the EAR/AI was met for only four micronutrients, raising questions as to the meaning of the total score. The scores were used to compare the rural and urban groups, but what is seen as a good or “protective” score and what would be considered an unhealthy score? No information is available on this in the literature and it is even possible that these definitions may vary between different study populations. In this population, a score needs to consider not only the prudence of the dietary intake but also the adequacy of the intake. There is, therefore, a need for the development of a DQS that is specifically adapted to take African dietary habits into account.

The urban group had better dietary patterns than the rural group (using both nutrient intake and DQS data), yet also had an increased risk for developing CVD. The contribution of diet to the risk of disease within the context of urbanisation is complex. It is difficult to evaluate the independent role of diet as there are other lifestyle changes taking place at the same time, such as decreased physical activity and increased psycho-social stress, as well as multiple other social and economic changes (Popkin, 2002a). It is difficult, therefore, to isolate the role of diet in a population in transition exposed to lifestyle changes, particularly with the added complexity of a low intake of dietary fat and micronutrients. Although the macronutrient intake of the urban group was higher than that of the rural group, the intake was still within the dietary guidelines. However, it was very close to the cut-off values for CVD prevention. It is likely that the low adequacy of the diet (micronutrient intake) played an additional role in the increased CVD risk in the urban population. It must be noted, however, that the rural group had an even lower micronutrient intake, with a lower risk of CVD. This raises an interesting question about interpreting the increase in CVD risk in relation to dietary guidelines in this context of a low micronutrient intake. It is possible that in the absence of the protective effect associated with adequate micronutrient intake, the modest increases in macronutrient intakes, despite still being within the guidelines for prevention of CVD, result in the observed increase in CVD risk factors. While dietary advice to the public should include messages regarding prudence, based on the increased macronutrient intakes of the

urbanised population, more emphasis should be placed on strategies to improve the adequacy of the diet, as both urban and rural communities currently have a generally poor micronutrient intake. The rural community is proving to be especially vulnerable in terms of dietary adequacy.

#### **6.4. THE ROLE OF DIET IN DIAGNOSED CAD IN THE CONTEXT OF URBANISATION**

When comparing the CAD patients with an apparently healthy reference group classified as having a low risk for CVD according to the Reynolds Risk Score, some observations were made that were similar to the comparisons between the rural and urban groups in the PURE study.

Firstly, the CAD patients had an atherogenic lipid profile and were overweight, with the women in this group classified as obese. When looking at dietary intake however, there was no difference in energy intake between the two groups. The CAD patients consumed more SFA and MUFA as percentage energy than did the reference group, which may have contributed, at least in part, to this higher level of obesity, possibly contributing to the development of CVD through the deleterious effects of adipose tissue. Several nutrients were identified that significantly increased the odds of being in the control or CAD group. These nutrients were confirmed by the food groups consumed by the two study groups when foods were entered in a logistic regression. The results of the two models clearly indicated that data on food intake are required to correctly interpret the results obtained from nutrient analysis, and that the association of diet with CVD is better explained by analysis of food intake, or both food and nutrient intake, rather than by nutrient intake alone.

The higher intake of ultra-processed foods in the CAD group could also have contributed to the development of CAD. Use of a further classification of food groups, other than the traditional classification based on processing, brings an exciting dimension to evaluating dietary habits and encompasses many factors known to play a role in the development of CVD. Foods undergoing a high degree of processing have been postulated as contributing to the development of non-communicable diseases (NCD) (Monteiro, 2009), although data linking ultra-processing to disease are still lacking. This is one of the first studies to indicate that the CAD patients did indeed consume more ultra-processed foods than the healthy reference group did. Ultra-processed foods are thought to contribute to the development of NCD as a result of a high energy density and a tendency to contain high amounts of added sugar, sodium, saturated fat or trans fat and little dietary fibre, with few micronutrients. According to the authors of this classification, diets that contain significant amounts of ultra-

processed foods are intrinsically nutritionally unbalanced and intrinsically harmful to health (Monteiro, 2009)

Another theme that was again highlighted by this paper (Chapter 5) was the issue of prudence versus adequacy in the urbanised South African population. The diets of the CAD group were higher in animal products and SFAs and, although higher in micronutrients, their diets were still not adequate when compared with EAR and AIs. The reference population had an even lower micronutrient intake, yet did not develop CAD.

## **6.5. RECOMMENDATIONS AND GENERAL CONCLUSION**

The following conclusions and recommendations for future research have emanated from the papers that form part of this thesis:

1. The results show that nutrient analysis of dietary intake alone is not sufficient to explain the relationship between diet and CVD. Additional techniques for assessment of dietary intake are therefore required, such as, for example, the use of food group and dietary pattern analysis.
2. Predefined DQS in non-Caucasian populations in developing countries should be used and interpreted with caution. The recommendation can be made that, for this black African population, an appropriate DQS should be developed that takes into account the unique issues of dietary intakes of black South Africans.
3. The use of a new food group classification based on the degree of processing holds promise in helping to better explain the relationship between diet and CVD. This topic of ultra-processed foods warrants further research, particularly in relating this food group to health outcomes.
4. Dietary advice for black Africans must include the factors that promote a prudent dietary intake, but should also focus especially on the adequacy aspect of dietary intake. Although the observed dietary changes are deleterious for the development of CVD in the urban population, the rural population has also proved to be nutritionally vulnerable, and should not be neglected.