Original Article

An Aboriginal-driven program to prevent, control and manage nutrition-related "lifestyle" diseases including diabetes

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Type 2 diabetes and other nutrition-related so-called "lifestyle" diseases, including obesity, and cardiovascular and chronic renal disease, are very prevalent in Australian Aboriginal people and contribute to their high rates of chronic illness and premature mortality. An Aboriginal-driven, community-based health protection, health promotion and improved disease detection, management and care program was introduced in four remote, discrete communities in the far north of Western Australia (WA) in order to attempt to prevent these disorders through community-based lifestyle modification. More energetic screening for early risk factors is involved as well as early dietary and exercise interventions and medical treatment, when indicated. Distinctive features of this program include its Aboriginal initiatives and perspectives, committed partnerships between the communities, the Unity of First People of Australia of Australia (UFPA) and its carers, the communities' health care providers, external clinical specialists, other external agencies and a locally-operated point-of-care (POC) pathology testing capability that is conducted by local and UFPA personnel. The POC component is quality managed by Flinders University. These features have ensured the viability of the program in three of the communities; the other one decided not to continue with the program despite risks of serious long-term health consequences. The pre-program prevalence of diabetes in screened adults was almost 40% and in adults aged ≥35 years was almost 60%. After several months of the program's operation, there have been positive changes in knowledge about food, nutrition, exercise and disease and altered attitudes and behaviours related to dietary and exercise patterns. There have also been improvements in weight control and in pathology test results relevant to the risk of subsequent development of diabetes and cardiovascular disease.

Key Words: Australian Aborigines, overweight, obesity, diabetes, cardiovascular disease

Introduction

As in many other previously traditional societies, nutrition-related diseases such as non-insulin-dependent diabetes mellitus (NIDDM or "diabetes"), cardiovascular disease and chronic renal failure are very prevalent in Australia's Indigenous population.[1] This is part of a much wider international problem which has been described as "a crisis in public health".[2,3] In Australia these so-called 'lifestyle' diseases have become the prime cause of premature mortality in the Indigenous population.[4] Much of this burden of illness, disability and premature death is preventable.

The rapid increase in diabetes may be related to the shift to 'Western' diets and lifestyle and a decline in physical exercise patterns.[5,6] Such changes are characteristic of a large proportion of Aboriginal Australians. They comprised the world's largest and most successful group of hunter-gatherers and, since European colonisation, have rapidly shifted to a more sedentary lifestyle with diets that are dominated by energy- (calorie)-dense foods. These are often high in saturated fats and refined sugars, low in fibre and high in salt; alcohol consumption is another addition to their contemporary consumption patterns that has serious nutritional implications.

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The incidence and prevalence of diabetes are increasing in the Aboriginal population. These rates are at least double to four times higher than non-Indigenous Australians[7] and in some Aboriginal communities the relative rates are very much higher.[8] It has been claimed that this may be because mainstream health services have failed Aboriginal people due to their ignorance or lack of understanding of Indigenous issues, their unwillingness to meaningfully engage Indigenous people in their own health, and because of the entrenched and widespread socio-economic and political disadvantages that the Indigenous minority experience in Australian society.[9]

In order to address these problems the Unity of First People of Australia (UFPA), a not-for-profit Aboriginal-run organisation, commenced a Diabetes Management and Care Program (DMCP) in discrete Aboriginal communities in remote parts of the north of Western Australia (WA) in 2002. This paper outlines the objectives of the UFPA program in those communities, how the programs were established, how they operate and some of the outcomes. Emphasis is given to the protection of health, the promotion of healthy lifestyles in the context of outback Aboriginal communities and, in particular, how nutrition-related health promotion can be delivered in meaningful ways to remote Aboriginal people.

Methods

The setting and the communities

These Aboriginal communities are in remote areas in the tropical north of WA. Each of them has its own community structure with elected chairpersons and councillors and committees that are responsible for various aspects of community life, such as health. One community is on the edge of the Gibson Desert in the Pilbara region, two others are in sparsely populated savannah bushland in the Fitzroy valley in the West Kimberley region and the fourth community is in the eastern part of the Kimberley. The community populations are approximately 200, 400, 350 and 400 persons, respectively. The people are quite mobile depending on community commitments such as funerals and traditional ceremonies, the latter especially at certain times of the year. They are located approximately 150 to 200 kms distant from the nearest towns. All are accessible by road and unsealed "bush" tracks, depending on whether or not flooding has affected travel by land, particularly in the summer "wet season". Each community has a nearby unsealed airstrip; these are unlit and cannot be used at night except in emergencies and may be unserviceable during wet weather.

Communities have a combination of traditional and, increasingly, Westernised styles of living. Despite having government schools and teachers on-site, unemployment rates are very high and many community members are dependent on social security. Each community has its own food store which is the main source of its food, drinks and general provisions. Supplies for the stores come mainly from major southern cities which are thousands of kilometres distant; provisions are usually delivered every week or so but this can be interrupted by unpredictable weather, such as cyclones and floods, sometimes for weeks or months. Community store supplies are generally much more expensive than in metropolitan areas or in major regional centres.[10] The communities are officially gazetted as "alcohol-free"; this can be enforced by government by-laws but these are sometimes infringed. Each community has its own clinic with resident or visiting nursing staff; the Pilbara community also has medical staff on site; one of the two doctors serves small and very remote, outlying desert communities, travelling by 4-wheel drive vehicle or by light aircraft. Government programs provide most of the community housing and infrastructure services but the prevailing standards are well below what is expected in the wider Australian community; consequently, serious infections of the skin, gastrointestinal, genitourinary and respiratory tracts are endemic.[11]

The "lifestyle" Diseases and Diabetes Management and Care Program (DMCP)

The UFPA has developed a Diabetes Management and Care Program (DMCP) for the special needs and problems of so-called 'lifestyle' diseases in remote Aboriginal communities in the north of WA. Participating communities expressed an interest to become involved then a process of discussion, explanation and negotiation occurred before formal, signed agreements committed the UFPA and the communities into mutual partnerships. This was done with very wide and lengthy community consultation and with the involvement of other stakeholders (Fig. 1). The main stakeholders in the Community include: the Community elders; the Community Council which is responsible for the governance of the Community; the Community Health Committee; an elected Community Diabetes Committee; the Community School and its teachers; the Community Shop and its management; and the Community Clinic and other health-care providers.

Objectives of the program

The main objectives of the Program are to (a) heighten awareness about lifestyle diseases like obesity and diabetes, (b) promote healthier living, including diet and regular exercise in order to minimise the possibility of developing risk factors for these diseases, (c) encourage earlier detection through community risk assessment programs and the judicious use of on-site point-of-care testing where appropriate, (d) institute earlier treatment when required, (e) encourage better compliance with medications, and (f) to undertake appropriate investigations [such as regular urine testing and retinal photography] and treatments [such as podiatry] to minimise long-term complications. The UFPA has gathered together a group of "carers", locally and from outside the communities, who bring high levels of awareness to the communities about food, nutrition, health and the risks associated with unhealthy diets and sedentary lifestyle using language and other messages that are appropriate and well understood by community people. The local people are often not comfortable with "high English", as they call it; they may have English only as a second or third language and many of them, especially older people, may be semi-literate or non-literate.

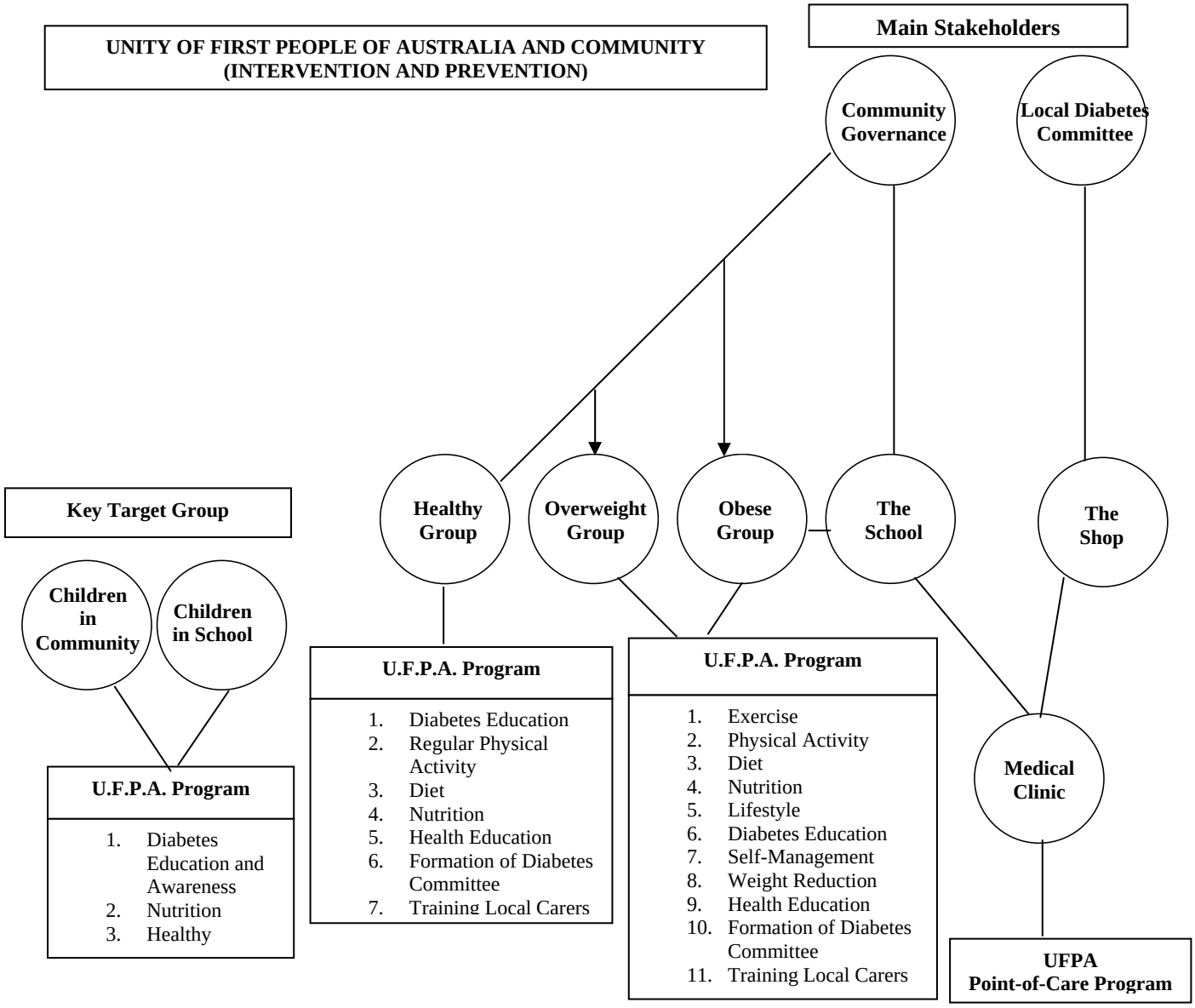

Figure 1. Main stakeholders in the UFPA Diabetes Management and Care Program

Implementation of the program

These chronic lifestyle diseases are often silently insidious for years while they develop progressively without causing symptoms; they can have their origins in apparently healthy, non-obese children[12] and may even commence during intrauterine growth.[13] The UFPA has, therefore, made children the key target group of its program (Fig. 1) in order to maximise its impact on health protection, health promotion and disease prevention or minimisation. Children are involved in education, increased awareness and the promotion of healthier living through better nutrition and the encouragement of regular exercise, sports and active recreation. The program has involved high-profile Olympic champion athletes Herb Elliott and Cathy Freeman in promoting healthy lifestyles among young people; other individuals and mentors have supported the sports and recreation program including well-known WA sports personalities and an international water polo team. Older community members are similarly involved with the program and are encouraged by the UFPA carers to become regularly more physically active. They also take part in the selection of and work on the communities' Diabetes Committees. They become very closely involved with the work of the UFPA carers and reinforce their role in the community. An important component is the use of visual teaching aids for health education. This is a readily comprehensible way to explain to Aboriginal people, adults and children, how relevant parts of the body, such as the heart, blood vessels, liver and pancreas, function during health and what goes wrong with them when risk factors for lifestyle diseases are commencing or when they have become established in diseases such as diabetes.

Health screening and risk assessment procedures

All community members are invited to take part in a health-screening program that includes personal and family history and clinical and physical (including anthropometric) assessment. This helps to identify overweight, obesity, diabetes (and its complications), cardiovascular risk, renal disease and biochemical indices. The procedures used to involve the communities in the program included a long process of explanation by Aboriginal

members of UFPA and members of its staff to the communities at public community meetings and to the Community Councils of what the program entails and how the information would be used for the benefit of participants and the communities. Informed and written permission was obtained from each of the Community Councils and with written permission of participants or their parents or guardians. Each participant was free to withdraw from the program at any time. The results were immediately given to participants' clinical carers and clinical and laboratory reports were included in the participants' clinical notes, often within minutes. Follow-up action was arranged for any individual requiring it. All information was coded confidentially and de-identified information about the health status of communities was quickly reported back in writing to the Community Council involved for its information and follow-up action. The procedures used conform to the NHMRC guidelines relating to work with Australian Aboriginal people. The following procedures and definitions were used:

Blood pressure was measured after 5 minutes of sitting using a Dinamap® Procare 300 which meets Australian National Heart Foundation guidelines: (http://www.heartfoundation.com.au/downloads/hypertension_management_guide_2004.pdf). Hypertension in adults was defined as a systolic blood pressure (BP) >140 mmHg or a diastolic BP >90 mm Hg.[14] The definition of hypertension in children and adolescents is related to age, gender and height. Normal BP is defined as systolic BP (SBP) and diastolic BP (DBP) measurements that are <90th percentile values; hypertension is defined as average SBP or DBP levels ≥ 95th percentile values. Average SBP or DBP levels that are ≥90th percentile but <95th percentile are designated as 'high normal'; these are considered to be an indication of increased risk of developing hypertension.[15]

Body weight in light clothing was measured by trained personnel using checked electronic or standardised and checked spring balance scales (to 100g). Body Mass Index (BMI) was determined by dividing body mass (kg) by height (metres^2). The following BMI cut-off points were used: 20-24.9 = acceptable; 25-29.9 = overweight; 30-34.9 = obese; ≥35 = extremely obese. Glycated haemoglobin (HbA1c) was measured on capillary whole blood using a portable DCA 2000 point of care analyser (Bayer Australia Ltd., Melbourne). Total-, HDL- and LDL-cholesterol, triglycerides and glucose were measured on capillary whole blood using a Cholestech LDX analyser (Point of Care Diagnostics, Sydney). All results were available within 10 minutes. Diabetes was defined by a known documented past history, a fasting glucose level of >7 mmol/L or symptoms suggestive of the diagnosis with random glucose >11.1 mmol/L or a plasma glucose of >11.1 mmol/L after glucose on oral glucose tolerance test (OGTT).

Probable diabetes was defined by biochemical evidence highly suggestive of diabetes (such as HbA1c >7%) but for whom proven evidence of diabetes, according to standard criteria (such as OGTT testing and fasting blood glucose measurements), was not feasible under remote outback field conditions. Dyslipidaemia in adults was defined as a circulating plasma cholesterol level of ≥5.5 mmol/L or LDL cholesterol ≥3.4 mmol/L or HDL cholesterol <1mmol/L or triglycerides ≥1.8 mmol/L.[16-18]

Dyslipidaemia was defined for pre-adults (up to 18 years) as a circulating plasma cholesterol level of ≥4.4 mmol/L or LDL cholesterol ≥2.8 mmol/L or HDL cholesterol <0.9 mmol/L or triglycerides ≥1.8 mmol/L.[19] This process of risk assessment assists in determining those who need further investigation and/or continuing clinical management. Those whose body weight is above normal also take part in self-management of their lifestyles and in supervised weight reduction. Adults are involved in these same elements of the program as are the children; they also take part in semi-structured physical activity programs and play an active role in selection of and working on the Diabetes Committees and in helping to improve the skills of the local DMCP "carers". The program identifies individuals who are overweight or obese and activities are devised for them and for all community members to undertake either as daily recreation (such as walking to and from the food store, the community centre, the school, the swimming hole and the airstrip) or as active sports such as basketball, football or swimming. This is done so that weight control and reduction can be supervised in sensitive and unthreatening ways. The whole community and all stakeholders, including the UFPA, must understand their places as partners in the program (Fig. 1). This is linked through the community clinic and the community risk assessment process with the point-of-care testing. These components collaborate with continuing medical care and follow-up for patients who require it.

Results

Health and risk assessment and disease screening surveys in the communities

Community-based health screening and risk assessment were undertaken in each of the communities. These were done after discussion, explanation and consultation with the Communities and their Councils and with their formal written permission and informed consent of the participants or their parents. The average ages, body weights, abdominal girths and Body Mass Index (BMI) measurements of adults are shown in Table 1. Sixty-one percent of 416 weighed adults were overweight or obese (Table 1). Using WHO upper limits of waist girths of 102 cm for men and 88 cm for women, 36% of the men and 75% of the women had abdominal obesity. If the recently proposed BMI cut-off point of healthy body mass for indigenous people (22kg/m^2) had been used,[20,21] 79% of the men and 86% of the women would have been overweight or obese. Forty-five percent of females of child-bearing or child-rearing age were obese. Using Cole's age-specific BMI equivalents[22] among 82 males and 126 females aged up to 18 years, 6 of the males (7.3%) and 16 of the females (12.7%) were in the BMI category of 25 – 30; 3 of the males (3.7%) and 2 of the females (1.6%) were in the BMI category >30; that is, 11% of the males and 14.3% of the females in this age group were overweight or obese (Fig. 2).

Table 1. Main features of adults in the community surveys[1]

Feature	Males	Females
Age (years)	38.7 ± 14.9 (range = 18 – 82) *N* = 181	41.0 ± 17.4 (range = 18 – 88) *N* = 237
Weight (kg)	81.9 ±19.8 (range = 48 – 151) *N* = 177	72.9 ± 19.2 (range = 29 – 157) *N* = 233
BMI (kg/m^2) BMI < 25 BMI 25 – 30 BMI >30	27.3 ± 5.9 69 (39%) 56 (31.6%) 52 (29.4%) *N* = 177	28.4 ± 7.2 80 (34.3%) 61 (26.2%) 92 (39.5%) *N* = 233
Waist girth (cm)	97.2 ± 14.9 *N* = 176	97.9 ± 17.8 *N* = 234
Systolic BP	134 ± 17 *N* = 176	122 ± 20 *N* = 234
Diastolic BP	80 ± 11 *N* = 176	76 ± 11 *N* = 234
Proportion with hypertension	75 (42.6%) *N* = 176	59 (25.2%) *N* = 234

[1]means and standard deviations are shown

Among adults, hypertension, defined as SBP >140 or DBP >90 or on treatment for hypertension, was documented in more than 40% of men and one quarter of the women. In those younger than 18 years, BP> 90th percentile for age and sex was found in 26 of 82 males (31.7%) and 25 of 126 females (19.8%). Twenty-three males (28.4%) and 10 females (7.9%) had BP>95th percentile for age and sex. Dyslipidaemia was prevalent in adults and pre-adults (Tables 2 and 3). Hypercholesterolaemia occurred in more than one-third of the men and one-in-eight of the women; low levels of HDL cholesterol and hypertriglyceridaemia were very prevalent among the adults (Table 2). Abnormal lipid profiles were prevalent in males and females aged up to 18 years. More than 12% of the pre-adult males and 16% of the females in this age group had high total cholesterol levels; low HDL cholesterol levels were found in similar proportions. One-third of males up to 18 years had low HDL cholesterol levels and almost one-quarter had abnormal triglyceride levels.

All participants were requested to fast overnight before blood samples were taken for assays. Results of plasma glucose and HbA1c (glycated haemoglobin) levels in adults and pre-adults are shown in Table 4. These may

Table 2. Plasma lipid levels in adults[1]

Variable	Males	Females
Total cholesterol (mmol/L)	5.3 ± 1.5 *N* = 165	4.7 ± 0.9 *N* = 212
LDL cholesterol (mmol/L)	3.1 ± 0.9 *N* = 139	2.5 ± 0.7 *N* = 205
HDL cholesterol (mmol/L)	1.0 ± 0.3 *N* = 162	1.0± 0.3 *N* = 209
Triglycerides[a] (mmol/L)	2.3 (2.1,2.6) *N* = 166	1.7 (1.6,1.8) *N* = 212
Total cholesterol ≥ 5.5 mmol/L	59 (35.8%) *N* = 165	26 (12.3%) *N* = 212
LDL Cholesterol ≥ 3.4 mmol/L	42 (30.2%) *N* = 139	28 (13.7%) *N* = 205
HDL Cholesterol < 1.0 mmol/L	83 (61.2%) *N* = 162	101 (48.3%) *N* = 209
Triglycerides ≥ 1.8 mmol/L	110 (66.3%) *N* = 166	101 (47.6%) *N* = 212

[1] geometric means and 95% confidence intervals

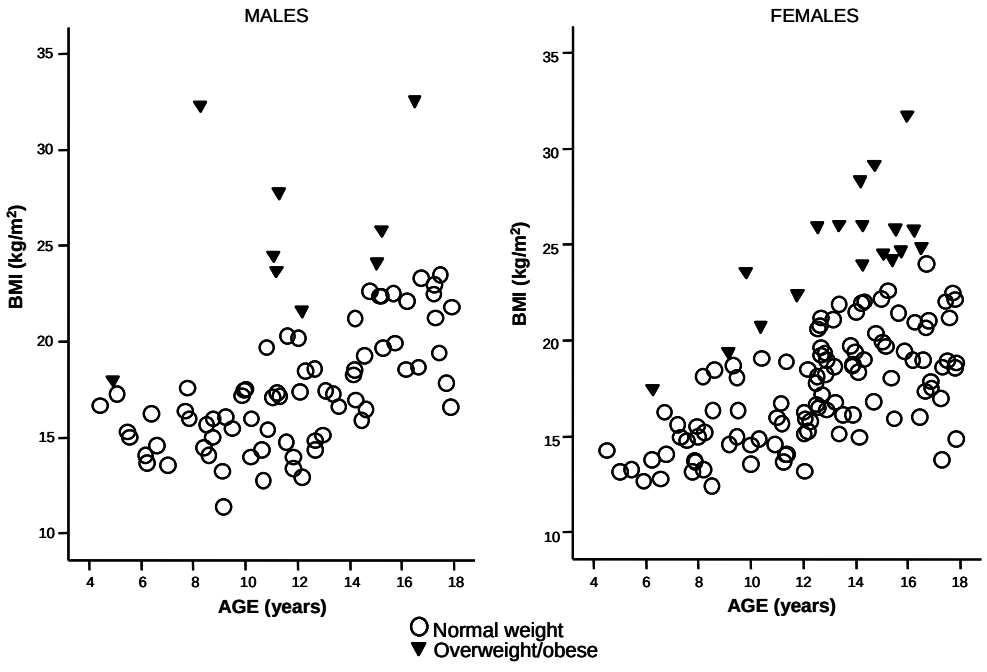

Figure 2. Body weight distribution of participants aged up to 18 years

Table 3. Plasma lipid levels in children and adolescents[1]

Variable	Males (N = 33)	Females (N = 50)
Total cholesterol (mmol/L)	3.7 ± 0.7	3.8 ± 0.8
LDL cholesterol (mmol/L)	2.2 ± 0.6	2.2 ± 0.7
HDL cholesterol (mmol/L)	1.1 ± 0.4	1.1 ± 0.2
Triglycerides (mmol/L)	0.9(0.9,1.3) [b]	1.0 (0.9,1.2)[2]
Total cholesterol ≥ 4.4	4 (12.1%)	8 (16%)
LDL cholesterol ≥ 2.8	4 (12.1%)	10 (20%)
HDL cholesterol < 0.9	11 (33.3%)	9 (18%)
Triglycerides ≥ 1.8	8 (24.2%)	6 (12%)

[1]participants up to 18 years of age
[2]geometric means and 95% confidence intervals

Table 4. Glucose and HbA1c levels in adults, children and adolescents

	Males	Females
Adults	7.58 ± 4.87	7.01 ± 3.95
Glucose (mmol/L)	(range = 3.3 – 28.3)	(range = 3.0 – 28.2)
	N = 177	N = 231
HbA1c (%)	6.41 (6.14,6.69)[1]	6.28 (6.07,6.5)[1]
	N = 161	N = 209
Pre-Adults	4.82 ± 0.51	4.76 ±0.74
Glucose (mmol/L)	(range = 4.1 – 6.0)	(range = 3.6 – 8.2)
	N = 41	N = 64
HbA1c (%)	5.22 (5.14,5.31)[1]	5.25 (5.16,5.34)[1]
	N = 43	N = 70

[1] geometric means and 95% confidence intervals; [2] participants up to 18 years of age; glucose results are given as means ± SD and with ranges given in parantheses

include results from some non-fasting individuals. Fasting glucose samples were obtained from 40 men and 79 women who were definitely fasted. The fasting glucose levels (mean ± SD) for men were 7.1 ± 4.8 mmol/L and for women were 5.8 ± 2.4 mmol/L. Nine of the men (22.5%) and 14 of the women (17.7%) had fasting glucose levels >7 mmol/L. Because of doubt about fasting status, levels were also considered as if they were random glucose samples. On that basis, 30/177 (16.9%) of men and 29/231 (12.6%) of the women had plasma glucose levels exceeding 11.1 mmol/L. Among 97 men and 100 women not known to be fasting, the mean log transformed insulin levels were 13.7 (CI = 10.8,17.4) and 16.3 (CI = 12.9,20.7) pmol/L, respectively. From 14 men and 30 women known to be fasting, the mean log transformed plasma insulin levels were 6.4 (CI = 3.2,12.8) and 10.0 (CI = 6.6,15.1) pmol/L, respectively. None of seven of the fasting men who were investigated had elevated 'homeostasis model assessment' (HOMA) index ratios but 7 of 19 (37%) tested women who were fasting had ratios ≥4 units (HOMA = (glucose [mmol/L] x insulin [pmol/ml] ÷ 22.5 and should be less than 4).[23] Forty-six of 93 men (49.5%) and 53/95 (55.8%) of women not known to be fasting had HOMA results ≥4. Overall, 39.6% of the adults (37.7% of men, 41.1% of women) had diabetes (documented history or fasting capillary blood glucose >11.1 mmol/L).[14] Almost 60% of adult males and females ≥ 35 years of age had diabetes documented by the same criteria. None of the 86 pre-adult males or the 132 pre-adult females who were tested had diabetes.

The following were used in risk factor analysis for lifestyle diseases. In adults: (1) hypertension, (2) elevated plasma cholesterol levels, (3) diabetes, (4) overweight or obesity. For children and adolescents up to 18 years: (1) elevated cholesterol levels, (2) overweight or obesity, (3) hypertension as previously defined. Among 294 adults, 27% had two risk factors, 21% had three risk factors and 6% had four risk factors. Among 82 participants aged up to 18 years, 33% had one risk factor, 5% had two risk factors and 2% had three risk factors.

Discussion

This work has shown that overweight, obesity and diabetes were very prevalent in a sample of several hundred Aboriginal people living in remote communities in the tropical north of WA. Sixty-one percent of men and 66% of women were obese or overweight (Table 1) and 36% of men and 75% of women had central or abdominal obesity. If the recently proposed lower cut-off points for BMI[20,21] were used even greater proportions of the adults would have been classified as overweight or obese. Forty-five percent of females of child-bearing and child-rearing age were obese; this is of particular relevance because children of obese mothers subsequently have an increased risk of themselves becoming overweight in early life.[24] Among those participants aged up to 18 years, 11% of the males and 14% of the females were overweight or obese. This is important because previous work among apparently healthy 7 to 18 year old Aboriginal children and adolescents living in the Kimberley region had a baseline prevalence rate of overweight of 2.7% that increased to 17.6% just five years later.[12] At follow-up five years later, at the mean age of 18.5 years, more than 8% of those subjects had impaired glucose tolerance, 2.7% had diabetes and more than 20% had hypercholesterolaemia. Dyslipidaemias were more common among females than males. This quick progression of diabetes and some of its precedents highlights the need for earlier detection and screening, where possible, for early indicators of risk of disease and earlier treatment and care, where indicated. Prevention, of course, is an even more important objective.

Hypertension was also prevalent among adults and pre-adults in the present study. Almost 43% of the men and more than one-quarter of the women were hypertensive. It is instructive to compare these findings with an extensive survey of 249 Aboriginal men and 241 Aboriginal women living in the Kimberley in the late 1980s.[25] That study found that approximately 8% of males and 25% of females aged 20 years and over were hypertensive. This suggests there has been an increase in the prevalence of hypertension in Aboriginal men in that

region in the intervening decade or so. The reason(s) for this are unclear. Alcohol drinking and increasing BMI were associated with hypertension in that earlier study[25] and these are possible causal factors in the present sample.

Dyslipidaemias were prevalent in adults and younger subjects, male and female, in this study (Tables 2,3). For example, more than one-third of men and >12% of women had hypercholesterolaemia. Abnormalities of the profiles of other lipids were also common; for example, involving LDL- and HDL-cholesterol. Hypertriglyceridaemia was present in two-thirds of men and almost half of the women. Abnormalities of lipid profiles were less prevalent in the subjects up to 18 years of age (Table 3). Risk factors for NIDDM can develop rapidly and without clinical warnings in Aboriginal people. A study done in 1979 in a remote Kimberley Aboriginal community showed that changes in lifestyle and diet (that is, from hunting and gathering indigenous foods and growing fruit, vegetables and livestock, to dependency on store foods) led to substantial increases in BMI, increased rates of diabetes and a drop in the age of onset and increased prevalence of dyslipidaemias in a little over 10 years.[26, 27]

Table 4 shows glucose and HbA1c results from adults, children and adolescents. Although the mean plasma glucose levels were only about 7 mmol/L for adults and <5 mmol/L among the children and adolescents, the range of results was very wide and some subjects had extremely high levels. Using all recorded glucose levels, 58 of 154 men (37.7%) and 81 of 197 women (41.4%) were categorised as diabetic; five individuals considered probably to have diabetes, but who did not undergo confirmatory tests, were excluded from this group. Among men and women at least 35 years old, 44 of 76 men (57.9%) and 66 of 112 women (58.9%) had diabetes, with the exclusion of one man and one woman with unconfirmed, but probable, diabetes.

Individuals had been requested to fast before samples were taken but this may not have always occurred. Among the 119 adults (40 men, 79 women) known to have fasted, 20% of men and 6.3% of women had plasma glucose levels >11.1 mmol/L (P = 0.029). The mean fasting glucose in these men was 7.1 ± 4.8 mmol/L and in the women was 5.8 ± 2.4 mmol/L. Twenty-five percent of all men and 26% of all women had HbA1c values above 7% while three quarters of diabetic men and two-thirds of diabetic women, respectively, had results in this abnormally high range. This may be because a substantial proportion of apparently non-diabetic adults had elevations of their plasma glucose levels over preceding months while the very high rates of elevated HbA1c levels among diabetics suggests strongly that their compliance with treatment regimes over the preceding three months was unsatisfactory.

Diabetes was very prevalent in adults. Only approximately 40% of adults 35 years and over were not definitely diabetic. This study has confirmed that diabetes and impaired glucose tolerance have reached epidemic proportions among Australian Aboriginal people.[1,8,21] We have also shown that multiple risk factors for diabetes and related 'lifestyle' diseases, such as cardiovascular disorders were very prevalent. These risk factors include overweight and obesity. There is strong evidence that these risks are related to the development and progression of glycaemic disease in indigenous populations.[28] Because diabetes has been becoming much more prevalent in Australian Aboriginal people, there is an urgent need to alter current strategies in order to arrest this trend. The UFPA developed its program, reported here, in response to this challenge. This has been done in an environment where Aboriginal people are often uncomfortable with so-called 'mainstream' health services and have had few opportunities to address their own health needs.

The program has now been in operation for many months to three years in the different communities. Because it involves the acquisition of knowledge, and alterations to attitudes and behaviours of people, positive changes will be slow. This is particularly because the program operates among people who, generally, are of low socio-economic status and mostly are not well informed about the links between nutrition, exercise and health. They are also disadvantaged by the general lack of availability of fresh, affordable, nutritious food and by poor knowledge of the value-for-money aspects of items for sale in their community food stores. This includes the comparative costs and nutritional value of fresh fruit and vegetables, canned or "dry" goods, sweets, ice cream, chocolates, cakes, biscuits, take-away fatty and salty fried foods, large bottles or containers of sweetened soft drinks, as well as the cost of consumable items such as guitars, television sets, videos, tape players, radios, clothes and household items. In addition, despite the bans on local consumption of alcohol, some community members spend substantial amounts of money on purchasing these items outside the community and on gambling. Despite this, the UFPA program has already achieved some encouraging results.

After several months in one Kimberley community, 49% of the participants had lost weight and 61% had lower BMI measurements. Improvements in BMI and laboratory findings tended to be more marked in diabetic rather than in non-diabetic persons. For example, BMI decreased on average by 0.6 kg/m^2 and improved in >50% of the diabetics and average waist circumference decreased in >60% of diabetics (average change =2.2 cm) between the first and second surveys. One young woman, a food store employee, lost 64 kg between the first and second screening surveys. There was also a decrease in average abdominal girths of more than 2cm and two-thirds of individuals had smaller abdominal girth measurements at follow-up.

Fifty-four percent had improved HbA1c results, 59% had lowered total plasma cholesterol levels (mean change = -0.134 mmol/L) and there were favourable changes in high density lipoprotein (HDL) cholesterol (mean change = +0.09 mmol/L) and low density lipoprotein (LDL) cholesterol (mean change = -0.38 mmol/L) lipid profiles. Statistical significance would be unlikely to be apparent after such a short time with such a small number of subjects. Increased physical activity has been one of the most remarkable changes in all of the communities. This has been helped by experienced sports trainers and UFPA carers and by the provision of better facilities for sport and active recreation, such as playing and football

grounds, floodlit basketball playing areas and well equipped gymnasia. Temperatures are often very high in these areas, particularly during the middle of the day, so activities have been designed appropriately. Nearby waterholes are used for swimming by two communities and football and basketball are now popular after school hours. Football matches are played regularly between two Kimberley communities despite them being separated by some hours' driving. Many community members now walk regularly, a remarkable change from previously; this includes mothers and other people pushing baby-prams, usually in the late afternoons.

Schools and their teachers have supported the program, for example through breakfast and lunch programs and by introduction of nutrition and health awareness into school activities and by starting fruit and vegetable gardens. The food store managers are now much more appreciative of the importance of nutrition to the well-being of their customers: increased emphasis is being given to providing more and fresher fruit and vegetables; leaner cuts of meat; providing less high-fat, high-salt, high-calorie (dietary energy) take-aways; reducing the availability of sweetened soft drinks and other high-sugar items; increasing the availability and appeal of fruit juices; and the use of coloured labels to help shoppers to choose their food and drinks. With sustained support from the program carers, communities have accepted having better diets as a core part of their effort to overcome lifestyle diseases.

In the desert community only 51% of the adult population was not diabetic. Seventy-eight percent of diabetics were either overweight (30%) or obese (48%) and 76% of the non-diabetics were either overweight (36%) or obese (40%) using standard BMI criteria. Twenty percent of the children were either overweight (12%) or obese (8%). About three-quarters of the adults and 23% of the children had *Acanthosis nigricans*, a darkish colouration and dermal thickening at the rear of the neck which indicates excessive circulating levels of insulin or resistance to the action of insulin; this reflects a high risk of the development of diabetes. The HbA1c levels in the diabetics were well above accepted normal limits, indicating unsatisfactory long-term compliance with management of their disease. One-third of the diabetics had elevated systolic BP and 15% had elevated diastolic BP. Twenty-two percent of diabetic adults had hypercholesterolaemia, 26% had hypertriglyceridaemia, 63% had elevated LDL levels and 41% had abnormal HDL levels. Among non-diabetic adults 11% had hypercholesterolaemia, 14% had hypertriglyceridaemia, 49% had elevated LDL levels, and 38% had abnormal HDL levels. These findings were considered to indicate that obesity, diabetes, cardiovascular disease and other lifestyle disorders were a serious threat to the future health of the people in this community. This was explained carefully, patiently and repeatedly to all of the key stakeholders including the elders, the community council, the community administrators, the food store managers and the community schoolteachers and the school principal. Meanwhile, the UFPA team went ahead for eight months with its program of food, nutrition and health awareness and with its exercise and active recreation program. This program was well accepted by community members themselves and was supported by their community clinic staff. This community has an advantage over the others by having a recently installed and well-maintained swimming pool which is used mainly by the children for exercise and relaxation and which the UFPA planned to use for more regular aquatic exercises through the involvement of professional water polo players as instructors and motivators.

Despite the patiently and carefully explained risks of worsening rates of overweight, obesity, diabetes, cardiovascular disease and other lifestyle disorders in the community unless active intervention strategies were adopted, the community council and administration decided against continuing the program. The effects of this decision can only be assessed as time passes; this may take some years and may be very costly in terms of human suffering and financial costs of treating chronic illnesses that are largely preventable.

Community # 4 is the first in which on-site point-of-care pathology testing has been given a strategically important role. This is occurring in collaboration with the Community Point-of-Care Services (CPS) at the Flinders University Rural Clinical School in Adelaide. This facility currently manages a national point-of-care HbA1c testing program in 60 Aboriginal Medical Services around Australia; this program is known as the Quality Assurance for Aboriginal Medical Services (QAAMS) program.[29,30] This is used to monitor HbA1c tests on Aboriginal people with diabetes. A key element of this program is the ongoing education and training of local Aboriginal Health Workers in the use of the portable DCA 2000 machine to measure HbA1c on finger-prick samples of capillary blood within 6 minutes[29] and a unique quality assurance program to constantly monitor the analytical performance of all sixty DCA 2000 machines in field use.[29] The Flinders' CPS unit manages another program known as Point-of-Care in Aboriginal Hands which, in addition to using the DCA 2000, also uses the Cholestech LDX point-of-care analyser[31] to test for lipid levels on capillary blood samples as part of community risk assessment, particularly in people who are at increased risk of premature cardiovascular disease. The UFPA has joined both programs run by the CPS to (a) enable intensive 'state-of-the art' quality management of the POC instruments to be used by the UFPA field workers for both risk assessment and management of chronic disease, (b) active involvement of local nurses, health workers and other assistants with POC technology, (c) help to upgrade the skills of community people in health and related activities such as clerical or administrative work. The ability to conduct POC testing on-site in communities confers many other advantages including the ability to perform the investigations on small finger-prick samples rather than using venous blood, (e) conduct POC testing on-site in communities and to provide results to the tested individuals and their clinical care-givers almost immediately; this assists with explanation of the results to participants and with arranging for further tests and/or other follow-up, if needed.

Conclusion

A 'lifestyle' modification program has been established in remote, discrete Aboriginal communities in the far north of WA in order to prevent chronic 'lifestyle' diseases, including type 2 diabetes mellitus, and their long-term complications. This program is Aboriginal-driven and community-based. It depends on committed partnerships between the Aboriginal communities, their local management (such as the school and the food store), their clinical service providers, the Unity of First People of Australia and its community-based carers, and the Community Point-of-Care Services unit at the Flinders University Rural Clinical School. The program explains and raises community awareness, in locally and culturally appropriate ways, why so many Aboriginal people become overweight or obese, develop diabetes, cardiovascular disease, and chronic renal disease and their complications. This is done by using patient, empathetic, community-based carers who understand Aboriginal people well and who are trusted by them. The program is founded on sound principles of developing, introducing and encouraging nutritious, affordable dietary habits and increased, regular exercise, sports and active leisure pursuits. Continuing clinical care for patients with established disease is an essential element of the program.

The work is actively supported by local clinical staff and by visiting specialists. The community-based health screening procedures have revealed high prevalence rates of overweight, obesity, abnormal glycated haemoglobin (HbA1c), insulin resistance, blood cholesterol and lipoprotein levels, and very high rates of diabetes and pre-diabetes. After several months of the intervention program there have been several encouraging improvements in risk factors for these chronic disorders in these communities. These include: much improved knowledge about the links between nutrition, diet, exercise, body weight and health; positively changed attitudes to accepting the program's diet and exercise recommendations; widespread reductions in body weights and BMI measurements; improvements in glycated haemoglobin (HbA1c), blood cholesterol and other lipid levels and improved supervision and compliance with medications in those patients who require them.

This Aboriginal-driven program could be applied in other parts of Australia and has recently been introduced into a metropolitan Aboriginal Health Service in Canberra, ACT.

Abbreviations

BMI (Body Mass Index) = body mass (kg) ÷ body height (in metres, squared)
HbA1c = glycated haemoglobin (glucose bound to circulating haemoglobin)
HDL = high-density lipoprotein
LDL = low-density lipoprotein

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Original Article

An Aboriginal-driven program to prevent, control and manage nutrition-related “lifestyle” diseases including diabetes

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一项由土著人发起的预防、控制和管理糖尿病等与营养相关的“生活方式”疾病的活动

2 型糖尿病和其它的与营养相关的所谓“生活方式”疾病，包括肥胖、心血管疾病和慢性肾脏疾病，在澳大利亚土著居民中很流行并且与这些居民慢性疾病的高发病率和较高的未成年人死亡率相关。一项由土著人发起的，以社区为基础的保护健康、促进健康和提高疾病检测、管理和护理的活动在四个位于澳大利亚西部边远的不同社区开展，旨在以社区为单位，通过改变生活方式来预防这些疾病。同时也开展对于早期危害因子的更有力监控及饮食和运动干预和药物治疗。该项目的显著特点包括它是由土著人发起，由社区、社区健康护理者、UFPA 机构、外来临床专家、其它外来机构和由本地和 UFPA 成员组成的 POC 病理检测机构共同协助开展。POC 机构由 Flinders 大学进行了质量管理，这个特点确保了在三个社区内开展项目的可能性，另一个社区尽管存在健康危害因素，但决定不继续开展该项目。在实施项目前，糖尿病发生率在所观察成年人中约为 40%，而在 35 岁以上成人中发病率约为 60%, 在实施项目几个月后,观察群体在对食物、营养、运动和疾病常识方面及对待与饮食和运动方式方面的态度和行动上有了积极的变化；另外，在体重控制及与糖尿病和心血管疾病发展过程中的危害因子相关的病理检测结果方面也有了改善。

关键词：澳大利亚土著人、体重、肥胖、糖尿病、心血管疾病。