

**An Analysis of the  
Usefulness and Feasibility  
of a Population Indicator of  
Childhood Obesity**

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MANATŪ HAORA

# Foreword

This paper provides an analysis of the usefulness and operational feasibility of an indicator to monitor both obesity in children and young people, and the effectiveness of the collective strategies and interventions used to prevent and manage childhood obesity. The work uses a 'Leading for Outcomes' approach, which is a systems-level framework employed by the Clinical Services Directorate of the Ministry of Health, with an initial focus on chronic disease prevention and management.

One of the overall goals of the Ministry of Health is to reduce obesity and its chronic disease sequelae. Applying an indicator of childhood obesity would be a useful tool to monitor the population and subgroups of the population, guide policy makers and funders to target interventions more appropriately, and measure the effectiveness of collective and individual interventions.

This paper was written by Dr Nikki Blair, as part of her advanced training in paediatrics, during a six-month attachment to the Ministry of Health. The content of this paper does not necessarily represent the Ministry of Health's viewpoint, but is intended to guide policy and funding decisions regarding childhood obesity prevention and management. The intended audience for this paper includes policy makers within the Ministry of Health and other relevant government departments, and District Health Board funders and planners.

Dr Pat Tuohy  
Chief Advisor Child and Youth Health

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# Introduction

## Chronic disease and obesity

Chronic diseases, in particular cardiovascular disease (CVD), diabetes and cancer, are the leading causes of morbidity and mortality in New Zealand adults, as in other developed nations (Ministry of Health 1999b, 2001a; World Health Organization 2003a). Chronic disease accounts for 80% of all adult deaths, the majority of hospitalisations and contributes significantly to the disparities of health status and life expectancy of Māori and Pacific peoples compared with non-Māori, non-Pacific peoples (Ajwani et al 2003; Ministry of Health 1999b, 2001a). The incidence of type 2 diabetes is increasing significantly, particularly among Māori and Pacific populations, and is also developing at younger ages. For example, between 1996 and 2002 the incidence of type 2 diabetes in Auckland adolescents increased six-fold (Hotu et al 2004).

In order to reduce the incidence and impact of these chronic diseases and reduce the accompanying inequalities, a life-course approach needs to be adopted, beginning with the health of the foetus, and continuing through childhood, adolescence and into adulthood (National Heart Forum 2003; World Health Organization 2003a, 2004). According to the World Health Organization (WHO), a life-course perspective is essential for the prevention and control of non-communicable diseases (World Health Organization 2004).

Both diabetes and CVD are often preceded by a collection of cardiovascular risk factors known collectively as the 'metabolic syndrome', which is the association between abdominal adiposity, glucose intolerance and insulin resistance, hypertension and dyslipidaemia (Vanhala et al 1998; Weiss et al 2004). There is evidence to show that if action is taken before or at the stage of metabolic syndrome, it is possible to avert the development of diabetes and CVD (Ferguson et al 1999; Reinehr and Andler 2004; Tuomilehto et al 2001). Furthermore, results from a population study indicate that if an obese child can reduce his/her relative weight to become a non-obese adult, this may protect against the metabolic syndrome (Vanhala et al 1998).

Adult obesity carries a significant burden of morbidity, mortality and financial cost. Obesity is the main modifiable driver of the type 2 diabetes epidemic and a significant risk factor for other diseases such as CVD, ischaemic stroke and several common cancers (Ministry of Health 2004c; World Health Organization 2000a). It is an early modifiable risk factor along the continuum from health, to the precursors of disease (metabolic syndrome), to disease and mortality.

Obesity in childhood and adolescence is associated with increased morbidity and mortality in adulthood. Long-term epidemiological studies have found childhood obesity to be associated with a 50–80% higher mortality in adulthood, predominantly related to CVD (French Institute of Health and Medical Research (Inserm) 2000). The only longitudinal study with adult body mass index (BMI)<sup>1</sup> data suggests that the increased risk of adult morbidity and mortality associated with childhood obesity cannot be fully explained by the persistence of obesity into adulthood.

<sup>1</sup> See section 2 for a discussion of BMI.

Obesity has reached epidemic levels in New Zealand and other developed countries. Among adult New Zealanders, between 1977 and 2003 there has been a dramatic rise in the prevalence of obesity from approximately 10% to 20%, whereas the prevalence of overweight has remained relatively stable (Ministry of Health 2004c). The pattern of BMI distributional shifting over this time shows a 'mixed' pattern, with some universal right shift and a modest increase in median (or mean) BMI but with most of the increase being found at higher percentiles (increased skewness). In plain terms this means that while there has been a small increase in the average adult BMI, the majority of the increase has occurred at the overweight end of the spectrum: overweight adults are becoming more overweight than in previous decades. This is compatible with the notion of differential susceptibility when individuals are exposed to the 'obesogenic' environment (Swinburn et al 1999).

For children, the only longitudinal data on BMI trends in New Zealand is from a study in the Hawke's Bay, which showed a two-fold increase in overweight and a four-fold increase in obesity in 11–12-year-olds between 1989 and 2000 (Turnbull et al 2004). The mean BMI increased from 18.1 to 19.8 over this period. Similarly, in other countries over the past 20–30 years a two- to four-fold increase in the prevalence of childhood obesity has been found (USA, UK, Australia), with a skewed distribution of BMI shift due to the heaviest children becoming even heavier (Ebbeling et al 2002). In the USA the rate of increase in prevalence was disproportionately higher in the minority ethnic groups compared to white groups over this period. So although the epidemic has affected children of a wide age range, from all ethnic groups and from all socioeconomic backgrounds, it has affected these groups disproportionately.

The levels of childhood obesity and overweight in New Zealand found in the recent National Children's Nutrition Study (NCNS 2002) were alarming (Health and Parnell 2003). Overall, of children aged 5–14 years, 21.3% were overweight and 9.8% were obese, using the Cole et al (2000) reference cut-offs values for determining overweight and obesity (Cole et al 2000; Ministry of Health and Parnell et al 2003).<sup>2</sup> Levels of overweight and obesity were higher for Pacific males (33.9% and 26.1%, respectively) and females (32.9% and 31%), followed by Māori females (30.6% and 16.7%) and males (19.6% and 15.7%), and then New Zealand European and Other females (18.8% and 6%) and males (18.4% and 4.7%). One important limitation to using these internationally recognised cut-off values is their possible inappropriateness for different ethnic groups, so that the prevalence of overweight and obesity may be overestimated for Māori and Pacific children. Earlier onset of puberty in Māori and Pacific females compared to European/Other was also thought to affect the data.

There is international evidence to show that the trajectory from overweight to obesity to eventual diabetes and CVD begins for many in childhood (French Institute of Health and Medical Research (Inserm) 2000; National Health and Medical Research Council 2003; Rocchini 2002; Sinha et al 2002; Vanhala et al 1998; Weiss et al 2004; Whitaker et al 1997). Relative body weight tracks from childhood to adulthood, and the predictive power of this association increases with age, the severity of the obesity and parental obesity (French Institute of Health and Medical Research (Inserm) 2000; National Health and Medical Research Council 2003; Whitaker et al 1997). The probability of

<sup>2</sup> See below for an explanation of the Cole et al cut-off values.

obesity status continuing into adulthood is estimated to be up to 20% at four years, 30–50% at seven years and 50–80% in adolescence (Guo and Chumlea 1999; Power et al 1997; Whitaker et al 1997). Conversely, this means spontaneous track-down (from obese or overweight to normal weight) becomes less likely the older the child gets, and is particularly rare in adolescence (National Health and Medical Research Council 2003). For children under three years of age the strongest predictor of adult obesity is the obesity status of a child's parents (Whitaker et al 1997). If both parents are obese, the risk of a child becoming an obese adult is 60–80% compared to a less than 10% risk when both parents are lean (Garn and Clark 1976). Longitudinal studies, however, have shown that fewer than a third of obese adults were obese in childhood (National Health and Medical Research Council 2003; Power et al 1997).

The Third National Health and Nutrition Examination Survey (1988–94) undertaken in the United States found that up to 24% of adults (over 20 years) met the criteria (three of five measurable variables) for metabolic syndrome (Ford et al 2002). Metabolic syndrome is also found in childhood, but only in the overweight and obese (Weiss et al 2004). A North American study found the prevalence of metabolic syndrome to be higher in obese compared with overweight children (29% versus 7%) and to increase with the severity of obesity, with up to 50% prevalence in severely obese children (Weiss et al 2004). Preliminary two-year follow-up of these children found the persistence of the metabolic syndrome in most and clinical progression to clinically defined type 2 diabetes a third.

Type 2 diabetes, previously unrecognised in adolescence, now accounts for one-third of all new cases of diabetes in this age group according to a recent Auckland study (Hotu et al 2004). Between surveys undertaken in 1996 and 2002, Hotu et al found the disturbing trend of a six-fold increase in the prevalence of type 2 diabetes in their adolescent diabetes clinic. Of the 76 cases of diabetes diagnosed between 1997 and 2001, 16 (22.8%) were type 2; 12.5% (6 of 48) for the years 1997–99 and 35% (10 of 28) in 2000/01. These findings are comparable to similar surveys in North America in the mid- to late 1990s (Pinhas-Hamiel et al 1996).

In the 2002 data the 18 young people with type 2 diabetes attending the Auckland clinic were all identified as of Māori or Pacific descent, with an equal male/female distribution. The disproportionately higher prevalence of type 2 diabetes among Māori and Pacific youth was thought to be explained by the greater prevalence of obesity in these ethnic groups (Hotu et al 2004; Tyrrell et al 2001). Because the Auckland findings were drawn from clinic referrals only, it is likely the data underestimated the number of affected subjects, as type 2 diabetes often has an insidious onset and thus may remain undetected for some time (Hotu et al 2004). For example, an American study found 4% of asymptomatic obese adolescents had silent (undetected) type 2 diabetes, and up to 25% of obese children and adolescents had impaired glucose tolerance (Sinha et al 2002).

Of the Auckland adolescents with type 2 diabetes screened for other risk factors, 85% had dyslipidaemia, 28% hypertension and 58% abnormal albuminuria (Hotu et al 2004). The outlook for affected adolescents is ominous, with high risk of premature macrovascular (heart disease and stroke) and microvascular (retinopathy and blindness, renal failure and neuropathy) diseases (Ebbeling et al 2002; Hotu et al 2004).

These individuals are likely to have significant morbidity by their 30s, with significant financial implications for the community. Already in Auckland, 40% of all new dialysis patients have reached end-stage renal failure due to diabetes, and over 90% of those have type 2 diabetes (Hotu et al 2004).

Currently, 115,000 adult New Zealanders are known to have type 2 diabetes, with an estimated equal number undiagnosed (Ministry of Health 2002). By 2011 the prevalence is expected to increase to 145,000, with higher percentage increases in Māori and Pacific peoples. The main drivers of this predicted increase are increasing obesity and physical inactivity, the ageing population, and an increasing number of Māori and Pacific peoples. Currently it is estimated that diabetes alone costs New Zealand over \$240 million each year. If the detection and prevention of diabetes is not pursued, it has been estimated that the cost to the health sector by 2020 will exceed a billion dollars.

The National Health and Medical Research Council (NHMRC) guidelines state that:

... the evidence that childhood obesity tracks into adulthood and significantly increases the risk of developing diabetes and cardiovascular disease, supports the screening, early identification and intervention of overweight and obesity in childhood. (French Institute of Health and Medical Research (Inserm) 2000; National Health and Medical Research Council 2003; Rocchini 2002; Sinha et al 2002; Vanhala et al 1998; Weiss et al 2004; Whitaker et al 1997)

The fact that persistence of obesity into adulthood is not inevitable lends support to the approach of making interventions in childhood (Nelson 2004). Reducing childhood overweight and obesity should lead to reduced adult obesity, metabolic syndrome and – most importantly – the incidence and impact of diabetes and CVD.

## **Leading for Outcomes**

Leading for Outcomes is a new systems-level approach to health care that has been developed within the Clinical Services Directorate of the Ministry of Health (Ministry of Health 2004b). It is the Ministry of Health's response to the internationally endorsed principles for action outlined by the WHO in its Global Strategy on Diet, Physical Activity and Health (World Health Organization 2003b, 2004). The first area the Leading for Outcomes team have focused their efforts on has been the prevention and management of chronic disease, in particular diabetes and CVD, essentially as a proof of concept.

'Leading for Outcomes provides a comprehensive framework for how we might collectively improve the health outcomes of all New Zealanders while reducing disparities between different groups in our society' (Ministry of Health 2004b). It encompasses all those in the health care system, whether in actual health care delivery, administration or policy, to maintain a focus on the overall results of our collective actions in terms of their outcomes. One of the most important outcomes is to reduce the incidence and impact of chronic disease, especially diabetes and CVD.

In order to achieve these outcomes it is essential to have a common purpose throughout the sector, to develop a system-wide awareness that encompasses the continuum of disease, and to embrace a systemic approach to chronic disease interventions. For the process of intervention to achieve the most beneficial outcomes it should be based on the best available evidence and be taken from a population health perspective, rather than the usual decontextualised, episodic care approach.

The Leading for Outcomes initiative utilises numerous approaches and techniques as a part of its development and change pathway, including:

- appreciative inquiry
- an outcomes approach
- systemic thinking
- managing for outcomes.

*Appreciative inquiry* involves looking for what works, how that can be improved, and then how it can be propagated more widely. Because people have actually experienced their own successes they are in a good position to know how to repeat them and expand on them. By finding examples of success and discussing them in detail, and by inspiring and affirming the efforts of those involved, the aim is to multiply success rather than allowing triumphs to be eclipsed by problems. We want to do more of what works.

An *outcomes approach* involves extending effort beyond immediate results (or outputs) towards accomplishing the broader goals or health outcomes. The consequences of all our collective actions as participants in the New Zealand health system should be the outcomes we are seeking to achieve – better health, reduction of disparities, trust and security, and increased participation and independence.

A 'system' is a conceptual framework. It is not a real entity, but a useful means of dealing with complexity. *Systemic thinking* accommodates the components of an organisation and the interactions among organisations, as well as the different contexts within which they operate. To operate systemically is to act consciously within that network of interactions and different contexts to influence their outcomes.

Leading for Outcomes has its origins in the State Services Commission's Managing for Outcomes framework, a project aimed at achieving a more responsive public service through:

- better evidence to strengthen decision-making
- better communication and improved interactions with stakeholders
- greater transparency and clearer accountability to Parliament and the public.

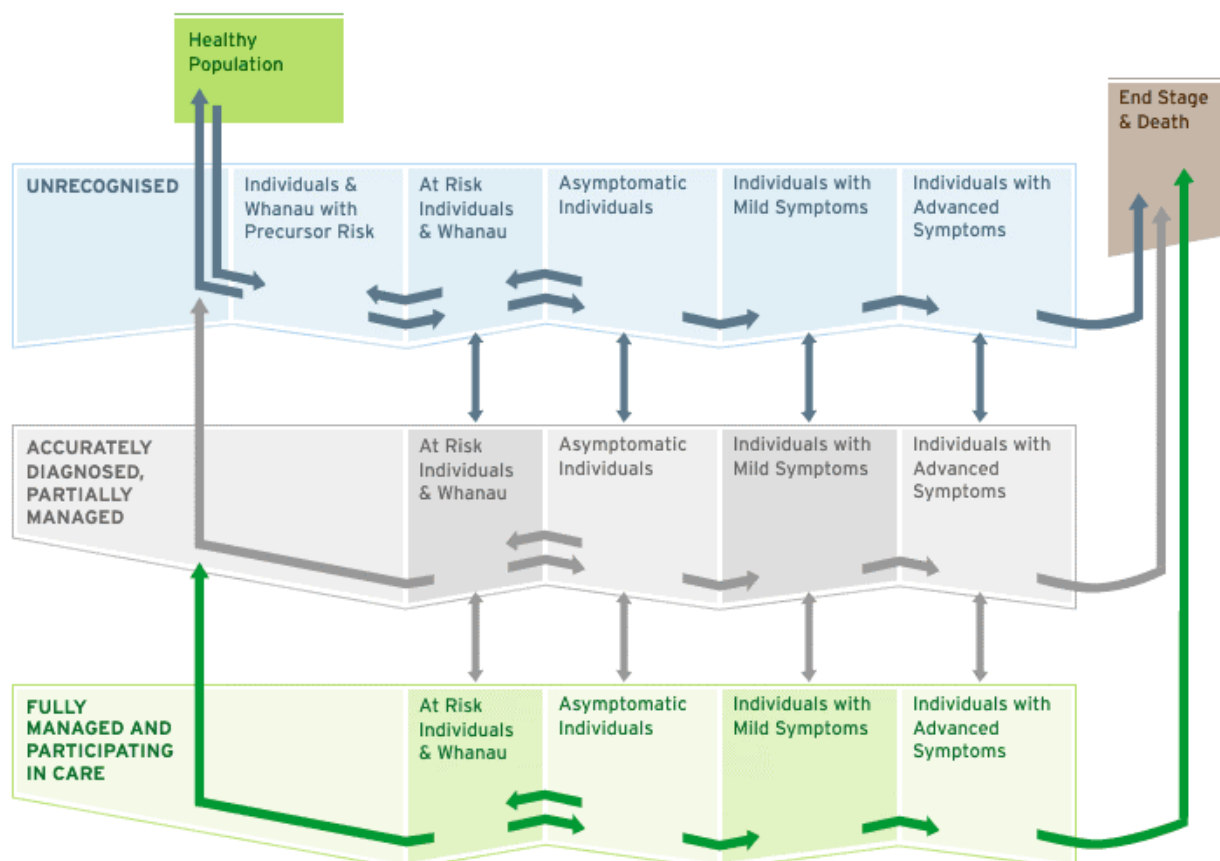
The State Services Commission requires that all government departments adopt 'a more strategic and outcomes-focused approach to management and reporting'. Departments must expand their focus beyond planning to 'the full cycle of management, encompassing direction-setting, planning, implementation, delivery and review'.

An essential component of assessing the effectiveness of our collective actions in contributing to outcomes is finding a way to measure or monitor our progress.

Outcome-linked indicators are the tools used for evaluation, systems performance monitoring, continuous learning and improvement.

The disease flow model in Figure 1 illustrates the whole-system continuum of disease and allows for a systemic approach to interventions. This flow model was specifically designed for diabetes and CVD, but can be applied to other chronic diseases, such as childhood obesity.

**Figure 1:** Leading for Outcomes chronic disease system flow model



Source: Leading for Outcomes: [www.leadingforoutcomes.org.nz](http://www.leadingforoutcomes.org.nz)

The aim is to both slow the progression of disease through its various stages (from the left to right in Figure 1) as well as ‘move’ the population of unrecognised or poorly managed cases into the ‘fully managed and participating in care’ category.

The impact of any interventions must be monitored. To do this, indicators need to be developed at all levels to monitor the system performance and the extent to which outcomes are achieved.

## Leading for Outcomes and childhood obesity

Applying a Leading for Outcomes approach to the management of childhood obesity has the potential to alter the current trajectory to adult obesity and its associated chronic diseases, CVD and diabetes, at a population level. The question of the best mix, level

and balance of interventions that over time will achieve the desired outcomes of a reduced incidence and impact of childhood obesity then needs to be answered.

As part of the Leading for Outcomes framework, an outcomes-focused indicator is required to monitor progress with curbing the childhood obesity epidemic. Candidate indicators, the various anthropometric measures and direct measures of obesity, will be identified and analysed for their usefulness as a systems performance indicator, and the best chosen for further evaluation. The aim of this paper is to ascertain the operational feasibility, usefulness, appropriateness, and costs and benefits of using the selected indicator to monitor the population and the effectiveness of our collective strategies and interventions to prevent and manage childhood obesity.

Population health monitoring is a useful support tool to inform social and health policy and programme implementation in the health sector (Ministry of Health 1999b; Nelson 2004). With high-quality population data collection, historical trends can be tracked and inequalities of health outcomes among nations and subgroups of the population can be compared. Further analysis can be done of the causal structure of these outcomes at multiple levels, including the physiological and behavioural risk factors of disease, and social, cultural, economic and environmental determinants. This analysis would suggest associations to explain the observed trends and differences in health outcomes, and an evidence base on which to base further research and interventions. Also, by the process of appreciative inquiry and a culture of information sharing, Leading for Outcomes aims to find and support what is working well – to build on the efforts that are already under way and carry that experience and expertise into the future (Ministry of Health 2004b).

## **Reversibility of disease risk**

As we have seen, it is important to prevent and treat obesity because of its strong correlation with serious chronic diseases, many of which are life limiting (Mulvihill and Quigley 2003). The most important long-term consequence of childhood obesity is its persistence into adulthood.

The results of a Finnish population-based study suggest that obesity that was established and sustained during childhood and was carried into adulthood is more harmful than obesity that appears in adulthood (Vanhala et al 1998). In this study obese adults who were obese as children had higher rates of cardiovascular risk factors and insulin resistance, collectively called the metabolic syndrome, compared to obese adults who were not obese in childhood. The odds ratio of having metabolic syndrome in adulthood increased from 16 for non-obese in childhood and obese adult, to 56 for obese in childhood and adulthood when compared to non-obese adults who were non-obese in childhood.

Another significant finding was that none of the subjects who were obese as children but non-obese as adults had metabolic syndrome. The authors concluded this finding suggests if an obese child reduces his/her relative weight to become a normal-weight adult, he/she would be protected against the development of metabolic syndrome.

Weight loss in adult overweight and obese individuals has resulted in improvement in physical, metabolic, endocrinological and psychological complications, and also a reduction in obesity-related mortality (Knowler et al 2002; Krebs et al 2002; Mulvihill and Quigley 2003; Tuomilehto et al 2001). However from studies in both children and adults it is clear that weight loss is difficult both to achieve and to sustain (Matyka and Barrett 2004). Therefore, it is important to know that weight loss in children, as in adults, will have health benefits.

Only a few small studies have assessed the health benefits of weight loss in children, mostly in terms of reduced cardiovascular risk factors. A recent study by Reinehr and Andler examined the amount of weight reduction required to improve the atherogenic profile and insulin resistance in children aged 4–15 years (Reinehr and Andler 2004). Only those children who lost significant relative weight (mean weight loss of 22%) and consequently reduced their BMI standard deviation score by 0.5 over the year achieved clinically significant improvements in their lipid profile, blood pressure and insulin resistance.

A few small studies have found exercise training alone, irrespective of associated weight loss, to have significant short-term health benefits (Ferguson et al 1999, Watts et al 2004a, Watts et al 2004b). Two studies by Watts et al found improved vascular function in obese children and adolescents, respectively, following eight weeks of exercise training (Watts et al 2004a, 2004b). In the adolescent group, circuit training also resulted in reduced abdominal and trunk fat, improved fitness in terms of functional capacity, and improved muscular strength (Watts et al 2004a). Ferguson et al found that after four months of an exercise programme obese children had improved insulin sensitivity, but this benefit was lost when they became less active again (Ferguson et al 1999). This highlights the importance of any intervention being sustainable.

There is some short-term evidence that reducing sedentary behaviours such as TV viewing in obese children is as effective for weight management as increasing physical activity (Epstein et al 2000). In this study by Epstein et al the children had a comprehensive family-based behavioural weight control programme including dietary advice, but were randomised to groups prescribing either reduction of sedentary behaviours or increase in physical activity. All groups showed significant reductions in percentage overweight at six months. Compliance levels were better in the group in which sedentary behaviours were targeted. This again highlights the importance of any intervention being acceptable to the patient and family, and therefore sustainable.

## **Adherence**

The Leading for Outcomes approach emphasises the important role that adherence to treatment and lifestyle changes plays in the management of obesity. Further research is required to identify factors that improve adherence to weight management programmes in children and adolescents, as with the treatment of any chronic disease. The majority of the successful treatment programmes reported in the literature have been undertaken in motivated individuals and families (National Health and Medical Research Council 2003). Studies by Epstein and colleagues are some of the most widely quoted studies of the management of childhood obesity, but the subjects were usually recruited through physicians and local newspaper advertisements, required at

least one parent willing to attend all sessions, and were intact white families of higher socioeconomic background (Epstein et al 1984, 1990, 1994, 1995, 1995a, 1995b, 1996; Epstein and Goldfield 1999). Given the intensity and duration of these interventions; the setting a university and the subjects motivated volunteers, concerns have been raised at the sustainability and generalisability of these intervention programmes (National Health and Medical Research Council 2003).

There remains a need for fully evaluated, cost-effective and generalisable interventions that target overweight and obesity in children and young people that can be implemented in a range of settings. Studies of positive 'effectiveness' are required where the setting used is one in which medical care is routinely delivered and thus can be implemented in the real world.

Anecdotally, the Kids in Action programme in South Auckland has found that those assessed as being motivated at the start of treatment were more likely to attend the exercise programme, comply with dietary advice and therefore succeed at weight management than those initially assessed to be of low motivation (Percival – personal communication).

This raises a number of questions:

- How best do we assess motivation levels and therefore target intervention more usefully?
- For those currently unmotivated or not ready to change, how can we use motivational counselling to shift them along the continuum of readiness to change?
- For any given group of obese children or adolescents, what are the key requirements to maximise adherence?

From a few long-term weight management studies in children, there is evidence to suggest that children (aged 6–12) have a higher degree of long-term success with weight management compared to adults (Epstein et al 1995a; National Health and Medical Research Council 2003). The Australian clinical practice guidelines therefore recommend that if a child is obese, weight management should start in childhood rather than being deferred to adolescence or adulthood (National Health and Medical Research Council 2003).

There are a number of psychological and physiological reasons why primary-school-aged children are more likely to succeed at long-term weight management (National Health and Medical Research Council 2003). For a start, children's weight management can be achieved through weight maintenance rather than weight loss, as the child has the potential to grow into their weight, therefore achieving relative weight loss. A child's behaviour patterns are still developing, so there is potential for modification. Also, parents are likely to have a stronger influence over modifying their child's environment and eating and activity behaviours in childhood than in adolescence.

There is evidence that weight management programmes that involve parents achieve better outcomes than those that do not involve parents (Golan and Crow 2004a; Mulvihill and Quigley 2003; National Health and Medical Research Council 2003; NHS Centre for Reviews and Dissemination 1997, 2002). Golan et al provided evidence that for primary-school-aged children, weight management programmes involving parents as

the sole agents of change may achieve better outcomes than those requiring the child's attendance (Golan and Crow 2004a, 2004b; Golan et al 1998). Their hypothesis was that:

... the focus on manipulating the environment using parents as the main agent of change and strengthening their leadership skills would help children overcome resistance to change and take the focus off them being identified as the (obese) patient.

Parents can alter their children's environments substantially, more so than for older children and adolescents, who are more influenced by messages outside the family environment (National Health and Medical Research Council 2003).

A goal of any long-term weight management intervention is to modify eating and exercise behaviours such that new, healthier behaviours develop, replace unhealthy behaviours and persist into adulthood (Epstein et al 1998). There are many examples in the literature of intense lifestyle interventions resulting in weight loss in the short term but with return to normal lifestyle habits and regain of weight at long-term follow-up (Epstein et al 1998). Guidelines on an approach to weight management in children and adolescents in primary care, published by the Royal College of Paediatrics and Child Health in conjunction with the National Obesity Forum, suggest aiming for small incremental changes in lifestyle behaviours, with the primary goal of management being 'a sustainable healthy lifestyle' (Gibson et al 2002).

## **Indicators**

An indicator, as used in the context of population health, is a measure that can be easily obtained at a population level. Because its use is for population monitoring, not clinical management, there is less need for an indicator to be precise. A good indicator is different from a good measure. A good measure for clinical use, such as a screening aid, needs to be sensitive and specific. A good indicator does not have to have such high sensitivity and specificity at an individual level, but should be able to detect differences between groups – concurrently or over time. Whereas screening aims to identify specific individuals who need a particular service/treatment by examining a whole population, indicators aim to identify trends in a whole population (or sections of a population) in order to forecast future needs for services for a whole population (or sections of a population).

## Outline of Paper

1. The first section of this paper will identify candidate indicators of obesity in childhood. From the candidate indicators, including anthropometric and direct measures of adiposity, the single best indicator will be identified by reviewing the literature and consulting experts whom work in obesity research and management. Criteria considered for this analysis included reliability, reproducibility and acceptability to the individual, along with the ability of the indicator to detect differences and trends in populations and subgroups. It will show that age-related BMI percentile to be the best indicator of obesity in childhood and adolescence.
2. Section 2 will assess the best age in childhood to apply the selected indicator (BMI) for the purpose of population monitoring. Criteria used in this analysis are accessibility, prevalence of obesity and consequently the ability to measure change and minimisation of potential harm. Analysis will draw on research, current practices and expert opinion.
3. In Section 3 the ethical considerations such as consent, privacy, psychosocial risks and costs will be discussed. These issues will be specifically assessed for the proposed population collection of BMI in childhood. These discussions will rely on formal documents, the Health Information Privacy Code and the Code of Health and Disability Services Consumers' Rights, expert opinion and current practices.
4. Section 4 describes the practical issues including the setting, the personnel requirements and the data collection process. This discussion mostly relies on expert opinion and experience.
5. Section 5 will look at how the introduction of a systems performance indicator of obesity in childhood will contribute to the overall goal of reducing the prevalence of childhood and thus adulthood obesity, and the associated chronic disease burden. This analysis will use research where available, and expert opinion and existing practice where it is not.

# 1 Potential Indicators of Obesity in Childhood

## Definition of obesity

Before looking at indicators of obesity we need to clarify what we mean by the term. A simple definition of obesity is excess adiposity or body fat mass, whereas overweight indicates excess weight for height regardless of the composition of weight (Burniat et al 2002). Although overweight and obesity are different conditions, in the literature they are often used interchangeably.

Using the definition of obesity as 'excess adiposity' required a suitable measure of body fat and a suitable cut-off to define 'excess' (Burniat et al 2002). In adults BMI (body mass index) is widely used as an index of relative adiposity on the basis that there is an increased risk of morbidity and mortality associated with higher BMIs. Cut-offs in adults for overweight has been set at BMI between 25 and 30 kg/m<sup>2</sup> and obese at over 30 kg/m<sup>2</sup>. For all ethnic groups BMI cut-offs are ultimately arbitrary rather than meeting true risk based thresholds. In fact the health risks, particularly Type 2 diabetes and CVD, associated with increasing BMI are continuous (log-linear) and begin at BMIs as low as 20 kg/m<sup>2</sup> (Ministry of Health 2004c; Willett et al 1999).

There are, however, identified limitations to using cut-offs of 25 and 30 kg/m<sup>2</sup> for adult overweight and obese respectively in certain ethnic groups and this is likely to be the case in children and adolescents as well. For any given BMI, Māori and Pacific peoples have a lower level of body fat, and Asian peoples a higher level of body fat (Ministry of Health 2004c; Swinburn 1998; World Health Organization 2000a). Currently there are no ethnic-specific BMI charts available but some researchers have proposed higher BMI cut-offs for overweight and obese in Māori and Pacific peoples (Duncan et al 2004; Rush et al 2003b; Swinburn 1998). The Ministry of Health has used the higher cut-offs of 26 for overweight and 32 for obese for adult Māori and Pacific (as recommended by Swinburn et al) in its recent publications including the National Nutrition Survey 1997, the New Zealand Health Strategy and the recent paper on '*Tracking the Obesity Epidemic*' (Ministry of Health 1999a, 2004c; Swinburn 1998).

Classifying obesity in childhood or adolescence is more complicated because height is still increasing, body composition is continually changing and there are significant differences in the age of onset of puberty between ethnicities and between the genders. Body composition, particularly fat mass, changes substantially with age and growth, pubertal stage and is different in boys and girls and those of different ethnicities (French Institute of Health and Medical Research (Inserm) 2000, National Health and Medical Research Council 2003). The proportion of fat mass over the total body weight is approximately 13–15% in term newborns, and this continues to increase over the first 12 months to a maximum of around 25–26%. From around 12 months until 4–6 years of age the percentage of body fat decreases, with increases in lean mass deposition to a nadir of around 12–16%. From about 6–10 years fat mass accumulation predominates, with lean mass deposition becoming prominent in adolescence, especially in boys. Early in adulthood the accepted normal percentage fat mass is around 20–25% in women and 15–20% in men (French Institute of Health and Medical Research (Inserm) 2000). The point at which there is a change from a tendency to

increasing leanness to increasing fatness at around 4–6 years of age was coined the term ‘adiposity rebound’ by Rolland-Cachera et al in 1984 (Rolland-Cachera et al 1984).

Assessment of adiposity in children is different to that in adults because; as children grow in size the anthropometric cut-offs need to be adjusted for age, and in adolescence for maturation as well (Burniat et al 2002; Power et al 1997). Many different definitions and measures of overweight and obesity in childhood and adolescence have been used in the literature and in clinical practice. Clinicians need a definition to enable them to identify children at highest risk of adverse health outcomes and for whom intervention is required (National Health and Medical Research Council 2003). Similarly, epidemiologists and public health practitioners require population measures that provide accurate estimates of body fatness to assist the monitoring of populations, for identifying high-risk groups, assessing the effectiveness of interventions and developing appropriate preventive strategies (Duncan et al 2004).

Because there is no simple, accurate direct method for assessing body fat in children and adolescents, anthropometric measures are usually used as surrogates for body composition (Sardinha et al 1999). Among these, waist circumference, waist-to-hip ratio, skinfold thickness and BMI (derived from height and weight measures) are the most commonly used. However, it is worth noting that the accuracy of all these measures depends on the skill of the operator and the precision of the equipment (National Health and Medical Research Council 2003).

In a 1997 review, Power et al stated:

Anthropometry is used not only at the individual level, as a clinical screening aid, but also at the population level to assess the health of groups. As a screening aid the assessment of obesity should be sensitive and specific, while as a public health tool it should detect differences between groups concurrently or over time. In the epidemiological situation there is less need for a cut-off, since the degree of obesity can be handled satisfactorily as a continuously varying quantity (Power et al 1997).

Power et al (1997) define the ideal measure of body fat as:

... accurate in its estimate of body fat; precise, with small measurement error; accessible, in terms of simplicity, cost and ease-of-use; acceptable to the subject; and well-documented, with published reference values (Power et al 1997).

They conclude that no current measure meets all these criteria, but that BMI is the single best measure of adiposity in childhood and adolescence. Ideally, population-specific reference data is needed (Matyka and Barrett 2004).

We will now look in more detail at the possible indicators of obesity.

## Body mass index

### Calculating BMI

Body mass index (BMI) is a weight-to-height ratio defined as weight (in kilograms) divided by the square of height (in metres):

$$\text{BMI} = \frac{\text{weight (kg)}}{(\text{height (m)})^2}$$

Weight is measured with the child wearing light clothing and no footwear, standing on scales and to the nearest 0.1 kg (National Health and Medical Research Council 2003). Height should be measured with the child (two years and over) standing without footwear, using a fixed wall or portable stadiometer and taken to the nearest mm.

The measurements of weight and height used to calculate BMI as an assessment of adiposity are reliable, reproducible and non-intrusive (Bellizzi and Dietz 1999). Both height and weight are simple and cheap to measure, although measuring height does require trained observers and continuous quality control to ensure high precision (Power et al 1997).

BMI would seem to be the anthropometric measure that provides the most useful population level indicator of excess body weight (Ministry of Health 2004c).

It has been validated against more direct measures of adiposity, such as dual-energy X-ray absorptiometry (DEXA) in childhood. The correlation between BMI and direct measures of adiposity varies in the studies from 0.5 to 0.85 (Lazarus et al 1996; Mei et al 2002; Pietrobelli et al 1998; Sardinha et al 1999). It has been shown to be a specific screening test with false-positive rates around 0.03-0.05. This means very few children would be incorrectly classified as overweight when they are not, but some overweight children would be incorrectly classified as being of normal weight.

A significant limitation of BMI is its inability to distinguish between fat and fat-free mass (Duncan et al 2004). This may result in BMI being a less sensitive measure of body fatness for children and adolescents from different ethnic groups, in those with high proportions of muscular development and possibly in those at the extremes of height or with unusual fat distribution (Must et al 1991; National Health and Medical Research Council 2003).

### BMI percentiles

BMI changes with age and gender, so an absolute BMI for a child must be calculated using an age and gender reference standard. Usually BMI-for-age percentile charts are used, with individual children being described as above or below percentile lines. These percentile charts are derived from data from a reference population. Some countries (eg, Britain, France and North America) have their own locally derived BMI-for-age charts (Burniat et al 2002; Must et al 1991; Power et al 1997). Neither New Zealand nor Australia have locally derived, nationally representative BMI-for-age references charts, and therefore are reliant on reference charts from other countries. Williams et al have published smoothed BMI reference curves derived from the

longitudinal data of the 1972 birth cohort from the Dunedin Multidisciplinary Health and Developmental Study in 2000, but these are not nationally representative or suitable for Māori and Pacific children (Williams 2000). Problems may arise if the chosen reference population does not represent the target population well, which is a concern in our multi-ethnic society. This will be examined further in the *Ethnicity and BMI* section to follow.

Widely accepted adult cut-off points for BMI; 25 kg/m<sup>2</sup> for overweight and 30 kg/m<sup>2</sup> for obesity correlate well with adverse health outcomes. There is no definite BMI level in childhood at which the risk of adverse health outcome is increased, although there is emerging evidence that metabolic syndrome is developing in children with BMIs in the higher range.

Currently there are two widely used international BMI reference charts for children, the Cole et al (Cole 2000) and the Centers for Disease Control and Prevention (CDC 2000), which are recommended for different purposes. The Cole cut offs, which were supported by the International Obesity Task Force and based on internationally pooled data sets from six countries, are recommended for research and epidemiological purposes (Cole et al 2000). Whereas the CDC 2000 charts, which are based entirely on US data of national health examinations between 1963 and 1994, are recommended for clinical use (CDC 2000). The Americans continue to use the CDC 2000 charts to determine population prevalence, whereas New Zealand and Australia have chosen to use the Cole charts for this purpose.

### **BMI percentiles for population monitoring**

The International Obesity Task Force expert committee, which convened in 1999, recommended that BMI cut-offs for overweight and obesity in children be based on the accepted adult BMI cut-offs (Bellizzi and Dietz 1999; Dietz and Bellizzi 1999). Subsequently, Cole et al developed a standard definition of child overweight and obesity based on adult cut-offs using an international reference population (Cole et al 2000). Cole et al used data sets from national surveys undertaken in six countries with widely divergent obesity rates:

- Great Britain (data pooled from five national growth surveys, 1978–93)
- Brazil (1989)
- Hong Kong (1993)
- the Netherlands (1980)
- Singapore (1993)
- United States (data pooled from four national surveys, 1963–80).

For each survey, centile curves were drawn that at 18 years passed through the corresponding adult cut-off points of 25 (adult overweight) and 30 (adult obesity). The resulting curves were then averaged to produce international cut-off points for BMI for overweight and obesity, by gender, between the ages of two and 18 years. Because the definitions of overweight and obesity using Cole cut-off points are less arbitrary and based on pooled international data, they can be used to compare populations worldwide.

Australia has chosen to use the Cole BMI curves for research and epidemiology purposes only (National Health and Medical Research Council 2003), and the NCNS 2002 also used Cole definitions of overweight and obesity (Ministry of Health 2003b). However, Cole et al advise that these cut-off points should not be used for clinical practice, because the data is not available as BMI-for-age reference charts.

One notable disadvantage of the Cole charts is that the reference data on which they are based is mostly from surveys from the 1980s onwards, when the prevalence of obesity had already significantly risen. It has been suggested that reference data from the 1960s would be preferable, because it would precede the onset of the obesity epidemic (Hofman – personal communication; National Health and Medical Research Council 2003). If reference data from after the 1960s is used there is a significant risk of underestimating the prevalence of obesity.

Some authors have found the Cole charts to be inferior to both the CDC and locally derived reference charts in terms of sensitivity for identifying obesity, but comparable when identifying overweight (Fu et al 2003; Reilly et al 2000; Reilly 2002). Both these authors (from England and Singapore, respectively) recommend using population-specific BMI cut-offs for screening, epidemiological and clinical purposes, and international cut-offs for international comparisons only. For epidemiological purposes, the lower sensitivity (46% in boys and 72% in girls) of the international cut-offs (Cole 2000) for obesity would result in substantial underestimation of obesity prevalence, particularly for boys (Reilly et al 2000). However, the overweight cut-off 'equivalent' to adult BMI of 25 has a more acceptable sensitivity of 90% in boys and 97% in girls.

Given that New Zealand have no population-specific reference data or cut-offs, the internationally derived Cole charts seem the best available option, while recognising their limitations in application to certain ethnic groups and the reduced sensitivity of identifying obesity but not overweight. It may be possible to use the overweight cut-off as the important indicator requiring intervention, rather than obesity, due to both the improvement in sensitivity and the potential health gain from intervening earlier.

## **Ethnicity and BMI**

New Zealand has an ethnically diverse population. Among adult New Zealanders:

- 80% identified as New Zealand European
- Māori 14.7%
- Asians 6.6%
- Pacific 6.5% (Statistics New Zealand 2004).

Children were found to be more ethnically diverse compared to adults in the recent census (2001), with 18% (versus 6% in adults) identifying with more than one ethnic group. Looking at the proportions for New Zealand children:

- 75% identified as New Zealand European
- 24% as Māori
- 11% as Pacific
- Asians 7%.

The proportion of Māori and Pacific peoples is higher in the younger age groups, with 40% of New Zealand births in 2001 of Māori or Pacific descent.

The appropriateness of international BMI-for-age cut-offs for New Zealand children from different ethnic groups remains controversial. If these reference levels are inappropriate for Māori and Pacific children, any results would overestimate the prevalence of overweight and obesity in these ethnic groups. A small study of New Zealand children (n = 79) by Rush found higher BMIs in Māori and Pacific compared to European children, but similar levels of percentage body fat (PBF) (Rush et al 2003a). Another study (n = 172) by the same research group found Māori and Pacific girls (ages 5–14 years) to have 3.7% lower body fat levels compared with European girls for any given BMI, which conversely meant that for any level of percentage body fat the equivalent BMI was 2 to 5 units higher (Rush et al 2003b). Similar differences in body composition were not demonstrated in boys.

A larger study (n = 2273) by Tyrell in Auckland primary school children found a significant difference in the relationship between body composition and BMI in Pacific children in the higher BMI (over 30) range only (Tyrell et al 2001). The authors concluded that this difference was not clinically significant and cautioned that accepting higher BMI values for Pacific children would be accepting a different level of health in these children, who are already at higher risk of obesity-related disease. They recommended that the same BMI cut-offs be used for New Zealand children of all ethnicities.

If differences in body composition and BMI cut-offs are relevant in childhood, it would particularly concern older children, especially post-pubertal, as this is when they take on more adult-like body compositions (Duncan et al 2004). Sexual maturation affects body composition, and therefore the association between BMI and fat mass. On average, Māori and Pacific youth sexually mature earlier than Europeans, who in turn mature earlier than Asian youth, and this is another reason for ethnic differences in body composition (Duncan et al 2004).

Conversely, researchers have found Asian peoples to have higher body fat for any given BMI and to be more prone to visceral and central obesity compared with Europeans (Duncan et al 2004). The WHO recommends lower cut-offs for overweight (BMI of 23) and obesity (BMI of 25) for Asian adult populations in the Asia–Pacific region, and this has implications for Asian children and adolescents (World Health Organization 2000a). Some unpublished data of a small sample of Asian children in the study by Tyrell et al found Asian–Indian children to have higher percentage body fat at any given BMI compared to New Zealand Europeans (Tyrell et al 2001).

Ideally, New Zealand would benefit from ethnic-specific BMI charts for Asian, Māori and Pacific children and adolescents, but the necessary large-scale New Zealand population studies have yet to be done.

## **BMI percentiles in clinical practice**

For clinical purposes, Australia has chosen to use the US CDC 2000 BMI percentile charts (Centers for Disease Control and Prevention 2002; National Health and Medical Research Council 2003). The CDC growth reference charts include gender- and age-specific BMI ranges with more percentile lines: 3rd, 5th, 10th, 25th, 50th, 75th, 85th, 90th, 95th and 97th, and are therefore more useful in the clinical setting. Using the CDC BMI percentile charts, overweight is defined as above or equal to the 85th percentile and obesity as above or equal to the 95th percentile.

These growth reference charts are based on data from five National Health and Nutrition Examination Surveys (NHANES) in the USA between 1963 and 1994, and five supplementary data sources. During this period there was a significant rise in the prevalence of obesity and overweight in childhood, so to avoid this increase causing an upward shift in the weight and BMI curves, the data from the most recent survey for children over six years was excluded. Although these reference charts are based on a reference population from just the one country, Australia chose to use these charts over those from other countries because the CDC charts were the most accessible and the prevalence of obesity and overweight was similar, as is the case for New Zealand children (National Health and Medical Research Council 2003). The WHO is considering developing international reference charts for clinical purposes, and these may be preferable for use in New Zealand and Australia if they become available (National Health and Medical Research Council 2003; World Health Organization 2000b).

Children who are obese and above the highest percentile are often off the BMI chart altogether. For these children, following BMI percentile as a method of monitoring outcomes of weight management would not be appropriate, even though an ultimate weight-loss goal would be a BMI percentile below the 85th, or the normal weight range. Children, like adults, need small and achievable goals. Options for monitoring weight management interventions in childhood and adolescence include:

- absolute weight loss (particularly in adolescence with no or limited height-growth potential or those with obesity related co-morbidities)
- weight maintenance, which equates to relative weight loss (children and some adolescents can grow into their current body weight, which creates a relative weight loss)
- BMI percentile changes with the ultimate goal of a 'healthy weight' range
- reduction in waist circumference (although no age-related circumferential numbers to aim for are available) (National Health and Medical Research Council 2003).

BMI would seem to be the anthropometric measure that provides the most useful population-level indicator of excess body weight (Health 2004c). It has been validated against more direct measures of adiposity, such as dual-energy X-ray absorptiometry (DEXA) in childhood. The correlation between BMI and direct measures of adiposity varies in the studies from 0.5 to 0.85 (Lazarus et al 1996; Mei et al 2002; Pietrobelli et al 1998; Sardinha et al 1999). It has been shown to be a specific screening test, with false positive rates around 0.03–0.05. This means very few children would be incorrectly classified as overweight when they are not, but some overweight children would be incorrectly classified as being of normal weight.

A significant limitation of BMI is its inability to distinguish between fat and fat-free mass (Duncan et al 2004). This may result in BMI being a less sensitive measure of body fatness for children and adolescents from different ethnic groups, in those with high proportions of muscular development, and possibly in those at the extremes of height or with unusual fat distribution (Must et al 1991; National Health and Medical Research Council 2003).

## **Waist circumference**

The usual method of measuring waist circumference (WC) is to have the subject standing wearing light clothing, and to use an anthropometric tape to measure the minimum circumference between the iliac crest and the rib cage, to the nearest 0.1 cm. However the methods for WC measurements have varied in the literature and the NHANES III protocol is a commonly used alternative (Centres for Disease Control and Prevention 2002; Janssen et al 2004; Wang 2003). The NHANES method was that used in the NCNS 2002 and by other New Zealand researchers (Ministry of Health 2003b; Graham and Rush – personal communication).

The NHANES III protocol uses just the one bony landmark, the iliac crest, and therefore minimises measurement error (Centres for Disease Control and Prevention 2002). The subject stands and the examiner, positioned at the right of the subject, palpates the upper hip bone to locate the right iliac crest. Just above the uppermost lateral border of the right iliac crest, a horizontal mark is drawn, and then crossed with a vertical mark on the mid-axillary line. The measuring tape is placed in a horizontal plane around the abdomen snugly at the level of this marked point on the right side of the trunk. The measurement is made at a normal minimal respiration and again to the nearest 0.1 cm. Although WC is an easy and inexpensive measure to take, it is subject to error from both intra-observer variability and the difficulty identifying the precise area to measure.

Fat distribution, in particular high central fat as a marker of increased intra-abdominal fat, is strongly correlated with cardiovascular risk in adults. There is a strong correlation (over 0.8) between measures of waist circumference and DEXA measures of trunk fat in children and adolescents (Taylor et al 2000). WC was found to be both a sensitive (87% boys, 89% girls) and specific (92% boys, 94% girls) measure of trunk fat mass. There is also evidence that WC measures in childhood track well into adulthood (Goran et al 1998).

Central adiposity is a key criterion for the presence of metabolic syndrome, and studies in children have found a positive correlation with other components of the metabolic syndrome, including dyslipidaemia and raised insulin levels (Higgins et al 2001; National Health and Medical Research Council 2003). A study by Janssen et al suggests that WC is a stronger marker of health risk than BMI in adults, but there has not been universal acceptance of this and BMI remains the most widely used measure (Janssen et al 2004).

The use of WC remains limited in children and adolescents because there are no universally accepted age-related cut-offs as there are in adults, and the relationship between WC and metabolic risk remains undefined. A recent cross-sectional study of pre-pubertal children by Higgins et al (2001) attempted to address this issue, and using

receiver operating characteristics (ROC) analysis determined body fat percentage and WC cut-off points associated with cardiovascular risk (Higgins et al 2001). They found children with 33% or more body fat and a WC of 71 cm or more to have an adverse cardiovascular profile, whereas those with body fat of 20% or less and WC of 61 cm or less to have a healthy cardiovascular profile.

There remains a need for local or international age-related reference charts for WC measures throughout childhood and adolescence. However, in clinical practice WC remains a useful tool to provide additional information about cardiovascular risk and to monitor response to lifestyle interventions. A reduction in WC could indicate loss of central fat, but there is insufficient data on circumferential measures for which to aim (National Health and Medical Research Council 2003).

### **Waist-to-hip ratio**

Waist circumference, as previously stated, is usually measured as the minimum circumference between the iliac crest and the ribcage. The hip circumference is measured as the maximum protuberance of the buttock, and both measurements combined allow the waist-to-hip (WHR) ratio to be calculated. The WHR has been found to be inferior to WC in determining trunk fat mass, and in relying on two separate measures is more prone to error (Taylor et al 2000). The main potential errors result from the difficulty of identifying the precise anatomical area to measure and high intra-operator variability (French Institute of Health and Medical Research (Inserm) 2000).

### **Skinfold thickness**

Skinfold thickness (SFT) measures subcutaneous fat and can be taken at multiple sites, most commonly at the triceps and sub-scapular regions. Using these measures, a calculation to predict total body fat can be made. The correlation between SFT and total body fat is reasonable. However, measuring SFT requires an expensive, specially designed calliper and a skilled operator. There is poor reproducibility of measuring SFT, both with a single observer measuring the same subject and for different observers (Power et al 1997). There are limitations in its use in more severely obese children, as the calliper may not be wide enough to obtain a reading (National Health and Medical Research Council 2003). Also, measuring SFT may be less acceptable to the child or adolescent, as they would be required to partially undress (Power et al 1997).

SFT varies with race, gender and age (National Health and Medical Research Council 2003). An American expert committee on childhood obesity suggested that although skinfold measurements are unreliable and inaccurate, a triceps skinfold higher than the 95 percentile, measured by an experienced observer, provides evidence of excess fat rather than increased lean body mass or large frame size (Barlow and Dietz 1998). There are published British and US (NHANES I) percentiles for skinfolds in childhood (Barlow and Dietz 1998; Must et al 1991; Tanner and Whitehouse 1975). However, there is minimal research on the association between SFT and metabolic syndrome and cardiovascular risk (National Health and Medical Research Council 2003). SFT may still have a role in clinical practice as an added measure to follow intervention progress and in research, but it is not sufficiently reliable, acceptable, reproducible or simple to perform to be useful as a population measure of obesity and overweight.

## **Other anthropometric measures**

There are other anthropometric measures, such as Benn's index, the ponderal index (weight (kg)/height (m)<sup>3</sup>) and the conicity index that have been proposed as useful measures of adiposity, but none offer any advantages over BMI and are more complex to calculate.

## **Direct measures of adiposity**

There are several methods of directly assessing body composition and thus total body fat mass, such as:

- bioelectrical impedance analysis (BIA)
- dual energy X-ray absorptiometry (DEXA)
- underwater weighing (hydrodensitometry) (National Health and Medical Research Council 2003).

These are largely research tools and usually available only in tertiary centres.

BIA, which was used in a subset of children in the NCNS, has recently become a low-cost, portable method, but there are limitations. Because the equation to convert the measured resistance by BIA into body composition uses height, weight, age and sex, it may add very little information to anthropometric measures. The equation used to convert resistance to body fat needs to be specific for the population that BIA is being measured in, but instead operators often use the manufacturer's formula, thus producing inaccurate results. Measurements can also be unreliable for bodyweight extremes and as a tool for longitudinal assessment (National Health and Medical Research Council 2003).

## **Summary and recommendations**

One purpose of this paper is to identify from candidate indicators the best indicator of obesity in childhood, and to assess the feasibility and usefulness of it as a systems performance indicator. The main contenders are body mass index and skin fold thickness (Power et al 1997). Of the two main contenders, BMI is more reproducible and acceptable to the subject, which is particularly important in adolescents. The measurements of weight and height used to calculate BMI are reliable, reproducible and non-intrusive. BMI has been validated against more direct measures of adiposity, with moderate sensitivity and high specificity. In terms of correlation with body fat, BMI is slightly inferior to that achieved by SFT. However, considering its other advantages, BMI is the best single measure.

Furthermore there is international consensus that age-related BMI remains the most cost-effective, reproducible and practical tool for both clinical and epidemiological use (Bellizzi and Dietz 1999; National Health and Medical Research Council 2003, Power et al 1997, Reilly 2002, World Health Organization 2000b). However, there are differences in which reference data and age-related charts are recommended for clinical and epidemiological purposes. Internationally, researchers and experts in the field of childhood obesity have concluded that BMI, though not a perfect measure due to its variation with height and age, is a reasonable indicator of adiposity or body fatness in

childhood (Barlow and Dietz 1998; Bellizzi and Dietz 1999; Cole et al 2000; Dietz and Bellizzi 1999; French Institute of Health and Medical Research (Inserm) 2000; National Health and Medical Research Council 2003).

There are internationally recognised gender-specific BMI cut-offs (Cole et al 2000) for children aged 2–18 years based on combined data sets from six countries, with the cut-offs for overweight and obesity corresponding to adult cut-offs. These cut-offs have been recommended as tools for research and epidemiological purposes, and allow countries and researchers to compare population prevalence of overweight and obesity. These cut-offs have also been endorsed by the NHMRC guidelines (Australia) and the NCNS 2002 (New Zealand), and will be used in the research Project Energize in Waikato (Graham 2004; Ministry of Health 2003b; National Health and Medical Research Council 2003).

Of note, for clinical assessment and management, including monitoring individual response to interventions, the Cole cut-offs are not appropriate. Instead, clinicians should use the CDC (2000) charts, which are based on an American reference population. The CDC growth reference charts include gender- and age-specific BMI ranges, including mean, standard deviations and multiple percentile lines, so are more useful in the clinical setting.

Having two different reference charts with different indications for use, has the potential to cause confusion.

Some authors have found the Cole charts to be inferior to both the CDC and locally derived reference charts in terms of sensitivity for identifying obesity, but comparable when identifying overweight (Fu et al 2003; Reilly et al 2000; Reilly 2002). They recommend using population-specific BMI cut-offs for screening, epidemiological and clinical purposes, and international cut-offs for international comparisons only. Given that New Zealand has no population-specific reference data or cut-offs, using the international charts by Cole et al seems the best available option, while recognising their limitations in application to certain ethnic groups and the reduced sensitivity of identifying obesity. The sensitivity for identifying overweight using the Cole charts is high (over 90%) while retaining acceptable specificity.

As a population indicator, BMI does not need to be a precise measure (high sensitivity and specificity) at an individual level. However, population BMI collection will allow trends to be followed, both in terms of mean BMI and its distribution and the prevalence of overweight and obesity for the population and within subgroups such as ethnic groups or communities. It would be a useful tool to detect differences between groups concurrently or over time. By identifying trends in the whole population or subgroups of the population, targeted interventions and forecasting for future service needs will be possible. The usefulness of collecting population BMI will be further discussed in Section 5.

## 2 Timing of BMI Collection

When assessing the best age to collect BMI at a population level the following issues need to be considered:

- accessibility to a health professional
- prevalence of obesity in the age group
- ability to measure change
- minimisation of potential harm
- predictability of obesity in adulthood
- the presence of modifiable lifestyle factors
- potential responsiveness of children or young people and their families to lifestyle and other interventions.

Of the above factors, the most relevant to deciding the best age for collecting BMI for the purpose of population monitoring are the first four: accessibility, prevalence of obesity, the consequent increased ability to measure change, and minimising potential harm. The final three factors are more relevant to screening, which is not the purpose of this proposal. They would be highly relevant issues if we were screening to identify significantly obese children for intervention (see Appendix 2).

To analyse the optimal age to collect BMI, the age brackets of five to six years, seven to nine years, 10 to 11 years and adolescents (12 years and over) have been used. These age groups are essentially arbitrary, but correspond to primary school entry, late primary, intermediate and high school, which is potentially useful for the practical issues and analysis related to setting. The criteria described above, combined with information from research (most notably the NCNS 2002), have been used to analyse the usefulness of measuring BMI in each of these age groups (Ministry of Health 2003b). Note that the age brackets chosen for comparison are different to those used in the NCNS 2002.

In the NCNS 2002, 25% of 5–6-year-old boys and 28.5% of the 5–6-year-old girls were classed as overweight or obese, and this increased to 33.4% and 33.9% respectively in the 11–14-year-old age group (Ministry of Health 2003b). Obesity prevalence increased minimally in boys, from 8.6% in 5–6-year-olds to 9.7% in 11–14-year-olds, but doubled in girls, from 6.7% in 5–6-year-olds to 11.5% in their teens.

Results from the NCNS 2002, which clustered children into age groups 5–6, 7–10 and 11–14-year-olds, demonstrated a decline in healthy lifestyle habits (Ministry of Health 2003b). The 5–6-year-olds had the best 'nutritional status', and were more likely to eat before school, take home-prepared lunches to school, eat fruit, and drink fewer sugary drinks. They were the most active age group and spent the least time in inactive pastimes such as TV watching. Older children had higher rates of skipped meals, higher rates of purchasing food from school canteens (markedly increased in the teenage group), higher consumption of sugary drinks and lower consumption of fruit, marked decreasing levels of physical activity and increased time spent in inactive pastimes. All these factors are associated with increasing BMI.

In the 17 years from 1985 to 2002 there has been no overall weight increase in New Zealand among 5–6-year-old children, whereas 14-year-old girls are now on average 6 kg heavier than they were in 1985, with no corresponding increase in average height (Wilson 2004). This was calculated comparing results from the NCNS 2002 with the National Children and Youth Fitness Survey, published by the Ministry of Education in 1985, which collected weight and height for children aged 6, 8, 10, 12 and 14 years (Ministry of Health 2003b; Ministry of Education 1985).

New Zealand children enter their school years physically active and eating well. Intervention strategies directed at maintaining healthy habits through into middle childhood and adolescence could therefore have significant impact on reducing obesity prevalence and severity.

At 4–6 years of age body fatness (and correspondingly BMI) normally declines to a minimum before increasing again, often referred to as the ‘adiposity rebound’ (French Institute of Health and Medical Research (Inserm) 2000; National Health and Medical Research Council 2003; Rolland-Cachera et al 1984; Whitaker et al 1998). Several researches have found the timing of the adiposity rebound to be important in the development of obesity, with the children at greater risk when the timing is early, before 5½ years (Dietz 1997; Rolland-Cachera et al 1984; Whitaker et al 1998). Children with an early adiposity rebound have an increased risk of adult obesity. This could mean that collecting BMI in the 7–8 year-old age group would identify children who had an early adiposity rebound, though these children would be more accurately identified by regular clinical monitoring of their BMI to observe increases in their BMI percentile.

**Table 1:** Summary of age group analysis for the collection of BMI for population monitoring of childhood obesity

Age (years)	5–6	7–9	10–11	12+
Accessibility	1	1	3	1
Prevalence of obesity	1	2	3	3
Ability to measure change	1	1	2	3
Minimisation of potential harm	3	3	2	1
Ability to influence behaviour	3	3	2	2
Overall	9	10	12	10

Grading system: 1: low; 2: moderate; 3: high.

## Age 5–6 years

The advantages of measuring obesity in this age group include the opportune time of school entry, potentially as part of the well child check at the family doctor, or as a health screen on entering school. However, getting good coverage may be difficult, especially if it relies on family attendance at the doctor. Measuring on school entry also has potential problems, particularly regarding the personnel conducting the measuring and the staggered time frame. A minority of schools have an on-site nurse, and the remainder would either require a public health nurse to come into the school or have a non-health professional undertake the measuring role. Training would be required for

all potential measurers, as would some form of ongoing quality control. The potential of psychological harm from the process of measuring, which becomes an issue in older children and adolescence, is likely to be negligible in this age group.

The prevalence of obesity among 5–6-year-olds is low, and so the ability to measure change over time is also low. If this age group were selected, then the measuring of obesity would only be an indicator of interventions and strategies that affected these children prior to 5 years of age, including maternal health, antenatal care and nutrition, infant and preschool nutrition and activity. From the NCNS 2002 it is known that 5–6-year-old children have the best nutritional status (physical activity and eating habits) of all the age groups, and therefore there is less potential gain from interventions upstream of this age group and less change to potentially measure (Ministry of Health 2003b).

### **Age 7–9 years**

As an older age group with mildly increased prevalence of overweight and obesity, there is an improved potential among 7–9-year-olds to observe changes in populations with time, and hence to monitor interventions affecting children earlier in their growth and development. As with the younger age group there is minimal potential psychological harm from the measuring process.

A significant disadvantage is the lack of any routine health professional contact that the measuring process could be linked with. The process of measuring children in this age group in the school setting could be met with resistance from schools, as it could be seen as an additional interruption to the school calendar and the delivery of the curriculum.

### **Age 10–11 years**

The most important advantage of monitoring obesity in this age group is accessibility, with two routine health contacts scheduled in year 7: the immunisation delivered by public health nurses, and the vision screening, delivered by hearing–vision screeners. If measuring is linked with either of these routine health contacts in schools, it is more likely the process will be more favourably received and supported by schools. Also, higher coverage rates could be achieved in the school setting than could be hoped for in the primary health care setting.

The experience of the public health unit in Marlborough, who have measured all year 7 students in 2002 and 2004 associated with the vision screening, is very encouraging (McMath – personal communication). They have achieved high measuring rates, with approximately 7% refusal. Linking this process to either of these current routine health contacts in schools is likely to be met by more support from schools than the alternative of an additional separate process, as would be required for all the other age groups.

Other advantages include the increased prevalence of overweight and obesity in this age group, particularly in girls, and therefore an improved ability to observe changes in the population in terms of BMI distribution and obesity rates that have resulted from prior interventions. Consequently this would be a better age group to apply a systems indicator to measure success or failure of interventions aimed at the prevention or reduction of childhood overweight and obesity.

Such interventions would be wide reaching and include:

- public health health-promotion messages
- school-based programmes, including the current Walking School Bus (WSB) scheme and Health Promoting Schools
- changes in advertising, pricing and other food-related environmental factors
- councils and town planners and other influences on the urban environment
- primary health care, maternity health and any specific obesity prevention programmes.

One suggested disadvantage of this age group is that children are becoming more sensitive about their weight and therefore vulnerable to potential psychological harm by the measuring process (Hofman – personal communication). Contrary to this concern is the experience of the Marlborough public health unit programme which reports no negative feedback from either the parents or the children who have had their BMI measured (McMath – personal communication).

## **Adolescents (12–16 years)**

The prevalence of overweight and obesity has further increased in this age group, with puberty being another critical time for the development of obesity. Measuring in adolescence has the greatest potential in terms of detecting change over time as a reflection of the interventions and strategies used.

The disadvantages of measuring obesity rates in this age group include no scheduled health contact with which to attach the process, and higher risks in terms of psychological harm from the measuring process. Adolescents are more likely to be sensitive about their body and weight, and uncomfortable with the measuring process, so potentially the process of measuring height and weight in this age group could have a negative effect.

## **Frequency**

Because the intention of collecting BMI is to monitor the prevalence of childhood obesity in the population and sub-populations, and the effect of interventions aimed at its prevention and management, information needs to be collected at regular intervals. To be responsive to the results of the data collection and enable better observation of trends, regular collection, such as annually, would be the ideal. If the process is undertaken in a school setting, one or two school terms could be selected in which to measure children, so that the timing in the school year is standardised. Annual collection would also be easier to maintain in terms of predictable personnel requirements and scheduling of time for the measuring process.

## Opportunistic intervention

Although this paper is addressing the selection of an appropriate indicator of obesity in childhood and the population monitoring of childhood obesity, this does not preclude the requirement a health professional has to identify individual children at high risk of overweight or obesity. This includes children from families where one or both parents are obese or with a strong family history of type 2 diabetes. General practitioners (GPs) and primary health organisations (PHOs) still have a responsibility to intervene opportunistically in overweight and obese children and adolescents, provide advice and guidance about good nutrition and activity levels, assess and manage co-morbidities, provide regular review (including monitoring lifestyle goals, weight and BMI) and refer on to specialist services as required.

North American guidelines recommend that interventions for childhood obesity should begin early (Barlow and Dietz 1998). These guidelines also highlight the important issue of motivation to change, which is especially relevant for a parent or adolescent. A weight management programme in those not ready to change may be not only futile but also potentially harmful if unsuccessful, as it could diminish the child's self-esteem and impair future efforts to intervene.

The National Health and Medical Research Council of Australia have produced *Clinical Practice Guidelines for the Management of Overweight and Obesity in Children and Adolescents* (2003) and these are available on [www.obesityguidelines.gov.au](http://www.obesityguidelines.gov.au) (National Health and Medical Research Council 2003). As New Zealand has no New Zealand-specific guidelines for the assessment and management of overweight and obesity, these are the best available resource. These guidelines conclude that studies to guide evidence-based practice are limited in number, scope, quality and size, so much of the guidelines are based on common sense and expert opinion rather than evidence.

## Summary and recommendations

From the analysis of the advantages and disadvantages of measuring obesity at a population level, the age group that has the most advantages with the fewest disadvantages is the 10–11-year-old age group. They have an opportune time for measurement associated with either of two established health contacts in the school environment. It is an age where the prevalence of obesity is moderate, and there is scope to improve maternal and infant health and the nutrition and activity habits of children in the early childhood years that contribute to the health and weight of children in the 10–11-year age group. Therefore, there is potential to improve the trends of childhood obesity, and have a measurable change over time that an indicator would be able to detect. Although some children in this age group are becoming more sensitive about their weight and the process of measuring could have a negative effect, if done well and in a routine manner, as is the experience of the Marlborough public health team, the potential for harm is very low.

### **3 Ethical Considerations, Risks and Costs**

#### **Consent**

An important issue that requires consideration is obtaining consent from the child and family. Certainly for researchers this is often a significant barrier, not to mention a time-consuming and therefore costly exercise (Graham, Hofman and Swinburn – personal communication). The experience in AIMHI schools, where measuring height and weight is part of a comprehensive health assessment and intervention, is contrary to this with consent rates approaching 100% (Woolston – personal communication). Several experts agree that for the purpose of collecting BMI for population monitoring, passive consent (ie, opt-out rather than opt-in) would be justified (Graham, McMath, Rush, Swinburn and Tuohy – personal communication).

Under the Code of Health and Disability Services Consumers' Rights 1996, informed (verbal) consent by the child, particularly the proposed 10–11-year-aged child, would be a legitimate option for this purpose (Health and Disability Commissioner 1996; Tuohy – personal communication). The children would be provided with information about the process in a way they can understand to obtain this informed consent. Prior to measuring, children and their families will need to have been provided with information about the measuring process and purpose, such as via a school newsletter, and therefore have the option to opt out. Note that in fact for the purpose of obtaining health information from an individual under the Health Information Privacy Code consent is not required, only awareness (Office of the Privacy Commissioner 2000; Harding – personal communication).

The Marlborough public health unit's experience regarding consent is encouraging (McMath – personal communication). They provided information about the measuring process and purpose in a routine newsletter, which gave parents the option to discuss the process further. Verbal consent was then obtained from children at the time of measuring. No family refused to have their child measured at the point of receiving the newsletter, and only 7% of children refused on the day of measuring.

#### **Privacy**

An intention of this paper is to assess methods of obtaining data on BMI and thus obesity rates in population cohorts of children and follow them over time, not to identify individuals. Policy will need to be written to ensure privacy issues are covered regarding the process of collection and collation of data to ensure a secure population database. The data needs to contain certain demographic information to optimise its usefulness for further analysis, such as ethnicity, age, gender, enrolled PHO, school decile level (as an indicator of socioeconomic status) and school location (to give geographical location and urban/rural status).

Information about obesity prevalence should be available for schools, PHOs and DHBs for children under their responsibility. Further analysis, including rates for boys and girls, for individual schools and for the main ethnic groups, could also be determined. Children and their families will need to be informed that the data collected will be used for these analytical purposes. If identifiable information is used, as would be the case using Kidslink, policy on the appropriate use of the data would be required. An individual's data and measurements would need to be protected, possibly by an encryption code, to maintain privacy. Only through specific ethical approval, such as for research or programme evaluation, would an individual's data be made available.

## **Psychosocial risks**

One of the governing principles of medicine is to do no harm. However, with anything we do there are potential risks alongside the benefits, and these need to be assessed. The label of obesity carries significant negative stigma, and so the process of measuring BMI needs to be done in a sensitive manner and care taken in choosing terminology.

Researchers are divided over the issue of whether or not to tell children and their families the results of the measurements and their interpretation. Certainly the lower-risk option is to not provide feedback, and thus avoid any potential psychological harm to the child and family that could result from the child being labelled as 'overweight' or 'obese'. Some researchers in Auckland and Australia have encountered negative reactions from parents when results have been provided, particularly for the child who does not look overweight but is on the border of normal weight and overweight (Hofman and Swinburn – personal communication).

Currently, researchers in Auckland and Waikato are opting to take the anonymous approach and not inform children and families of their results at the time of measuring (Graham and Hofman – personal communication). However, the Project Energize programme (Waikato) will involve the measurer identifying any at-risk children by comparing their measurements with internationally validated measurements for height, blood pressure or BMI (Graham – personal communication). Later the researcher will send out an individualised referral letter to the children identified as at-risk and their families, requesting them to attend a follow-up assessment with their GP. In the letter there will be the suggestion of further referral to the paediatric service and/or the Body Wise Clinic (multi-faceted weight management programme), as required.

The health and psychosocial assessment of all year 9 students at AIMHI schools in South Auckland includes measuring BMI (height and weight) and blood pressure (Woolston – personal communication). The school nurse takes these assessments in the privacy of a clinic room, and the results of these measures are given to the client in a sensitive manner as part of a discussion of healthy nutrition, physical activity and family history. The full assessment and feedback with each young person takes around one hour, and ongoing follow-up may take another one to two hours. The experience in AIMHI schools has shown that giving feedback to children and youth can be done well, in a sensitive and appropriate way, but this does involve well-trained personnel (especially in counselling techniques and youth health) and time.

Not giving out the results could also be seen as a missed opportunity (Swinburn – personal communication). Feedback of results: including the calculated BMI, the corresponding weight category (normal weight, overweight or obese) and an explanation of what it means, is potentially very useful. In itself, giving feedback could provide the impetus for a family to make some healthy lifestyle changes or to seek professional help. Professor Boyd Swinburn, of Deakin University, Victoria, Australia and formerly of the University of Auckland, is currently involved in two significant studies involving large-scale BMI collection in children, the OPIC (Obesity Prevention in Communities) study and the Colac study, and his research team have elected to provide feedback (Swinburn – personal communication).

Terminology is cited as an important issue, and many researchers have used the term ‘at risk of overweight’ for what is usually described as overweight (> 85th percentile or BMI-for-age equivalent to adult BMI of 25), and ‘overweight’ for what is usually described as obese (> 95th percentile or > BMI-for-age equivalent to adult BMI of 30) (Graham and Swinburn – personal communication).

Associate Professor Elaine Rush, of the Auckland University of Technology, who undertook research about bioimpedance measures in a sub-population of the NCNS 2002 and other significant research into childhood body composition, recommends giving children the results of their height and weight measures to take home, but not the BMI and its interpretation (Rush – personal communication). This means children and their parents receive something for their participation without the significant psychological risks of giving feedback of weight categories. This is the option the Marlborough Public Health Unit has taken when measuring year 7 students (McMath – personal communication). They have the recent experience of measuring over 500 children, and have had no negative feedback regarding the measuring process from parents or children.

To provide feedback in a manner that minimises potential psychological harm would require:

1. well-trained professionals with counselling skills in dietary and lifestyle change
2. adequate time
3. availability of appropriate and effective obesity management services
4. consideration of culture and provision of language interpreters as required.

As these requirements cannot be currently met, and more importantly a population rather than individual approach to obesity is the purpose of this proposal, the option to not provide feedback is recommended.

In summary, the main purpose of the proposed population collection of BMI is to monitor populations and act as a performance indicator of interventions aimed at reducing childhood obesity and adult chronic disease, not to screen and identify children with obesity for treatment. With the associated risks of providing feedback of results to children and their families – particularly if not done well, by well-trained professionals with skills in counselling, with sufficient time and without adequate interventions available to refer on to – the best option is to not provide individual feedback. Regardless, children and youth need to be measured in a manner that preserves their

privacy and dignity. In practical terms, this would mean the child is measured in private, with only shoes and heavy outer clothing (such as coats and jackets) removed and in a sensitive manner.

## **Financial costs**

Costs for the process of collecting BMI in childhood at the population level have not been calculated. However, the Marlborough public health team have provided their estimates of costs for their annual programme of measuring BMI in all year 7 students in the Marlborough region (McMath – personal communication) (see Appendix 5 for these estimates.) Using the calculated estimate of \$2 per child (after the initial cost of purchasing equipment) to measure all year 7 New Zealand children (approximately 55,000), the cost to the health sector would be about \$110,000 annually.

## **Obligation to intervene**

In discussing the psychosocial risks of telling a child and their parents the results of BMI measurements, we did not address the question of whether we have an ethical obligation to act when obesity or overweight is identified. The purpose of this paper is to take a population, rather than an individual, approach to the prevention and management of childhood obesity, and so individually tailored interventions for those identified as obese or overweight was not the primary purpose of this work. However, clinicians could argue that if one does identify a child with a significant health problem, in this case obesity, it is one's duty and responsibility to inform the child and family of this, and to offer intervention or referral to the appropriate services. Others would argue that potentially the most effective interventions are at a population level, and that this information is assisting in targeting and deciding the amount and nature of resources needed for this purpose.

In some areas of New Zealand there are specific intervention programmes – Bodywise in Waikato, Kids in Action in South Auckland, Food with Attitude in Central Auckland and Marlborough, and the Lifestyle Clinic in Whangarei. In a recent stocktake, undertaken by the Ministry of Health, of obesity intervention initiatives requested of District Health Boards (DHBs), these were the only centres that identified family-based multi-faceted programmes (see Appendix 4). Currently other centres around the country do not have access to such intervention programmes.

From the international literature there is evidence that multi-faceted family-based behaviour modification programmes (comprising diet, exercise, reducing sedentary behaviours and parenting skills) and family-based interventions targeting parents and children together (involving at least one parent with physical activity and health promotion) are effective in treating overweight and obese children (Mulvihill and Quigley 2003; National Health and Medical Research Council 2003, NHS Centre for Reviews and Dissemination 1997; NHS Centre for Reviews and Dissemination 2002). There is, however, a lack of evidence regarding the effectiveness of interventions targeting specific socioeconomic, ethnic and other vulnerable groups (Mulvihill and Quigley 2003).

The only New Zealand-based programme with some initial evaluation is the Kids in Action programme, in South Auckland, which has a high proportion of Pacific children. Of the 63 children who attended for more than two weeks, 70% lost or maintained weight and 48% lost weight (Percival – personal communication). Given the high prevalence of childhood obesity (around 30% in some areas), these programmes are neither sufficiently equipped nor resourced to cater for the majority of obese or overweight children.

In 2003/04 SPARC (Sports and Recreation New Zealand) funded three regional sports trusts (Auckland, Waikato and Tasman) to deliver green prescriptions to children and youth who are at risk of suffering adverse health affects from being overweight or obese (O'Neill – personal communication). These programmes involve attending several weekly physical activity sessions, individualised programmes of increased activity (aiming for one hour per day of moderate intensity activity most days), reducing sedentary activity time, improving nutrition, ongoing support and monitoring over 6–12 months, and long-term strategies to maintain physical activity at the end of the programme, including involving the family and assessing options in the community. Green prescriptions in children are yet to be fully evaluated, though a significant problem of adherence (around 30% do not complete the programme) has been noted. Despite this, the programme has been expanded to include three further sports trusts: Hawke's Bay, Harbour (North Shore, Auckland) and Canterbury for 2004/05.

Despite the lack of specific obesity intervention programmes around the country and the limited resources of current programmes, we envisage PHOs taking on new initiatives to tackle obesity prevention, improve nutrition and physical activity. The anticipated shift in focus of primary care to a population health approach, health promotion and disease prevention would encourage such initiatives. This may involve PHOs taking a multidisciplinary team approach, perhaps with practice nurses or dieticians taking lead roles in the delivery of prevention and intervention programmes targeting childhood obesity and overweight.

GPs or primary care providers are well placed to play a key role in the prevention and management of obesity, in part because of their unique position. In Australia, and New Zealand is likely to be similar, GPs have contact with 80% of the population in any one year, and are the most likely source of information about weight management. There is evidence that they can be effective in health promotion, as has been shown by trials assessing GP counselling for interventions in smoking cessation and alcohol reduction (Ashenden et al 1997).

The Australian clinical practice guidelines<sup>3</sup> are a useful resource to base such programmes on. In time it is hoped that current and new initiatives in New Zealand populations will be further developed and evaluated. If programmes are found to be effective, there needs to be an information sharing process to allow the expansion of effective programmes. There is a particular need for more initiatives targeting high-risk populations such as Pacific and Māori children and their families. For these groups, conventional approaches may be ineffective, so consideration of the appropriate setting and the cultural acceptability of the programmes and their providers is needed.

<sup>3</sup> Available on [www.obesityguidelines.govt.au](http://www.obesityguidelines.govt.au).

The Pacific OPIC study aims to fill the evidence gap around obesity prevention among young Pacific populations. The current best theoretical approach to obesity prevention is for comprehensive community-based programmes. This study will evaluate the overall impact (including cost effectiveness) of such intervention programmes on the prevalence of overweight and obesity in young populations in Fiji, Tonga, New Zealand (Mangere) and Australia over the next few years. It is a collaborative study between the University of Auckland, Deakin University (Victoria, Australia) and the Fiji School of Medicine. Other aims of the study include assessment of the feasibility of specific intervention components and their impacts on eating and physical activity patterns, determining the sociocultural factors that promote obesity and how they can be influenced, assessing the effect of food-related policies and food supply, and determining how resources to prevent obesity can be best allocated.

In summary, the purpose of the proposed collection of childhood BMI is to take a population approach, to have a robust method to monitor trends in childhood obesity at a national and local level, within different ethnic groups and communities, and to monitor the impact of interventions that aim to reduce overweight and obesity. The primary aim is not to screen children and identify those at risk, or to offer individualised treatment. We already know that around one-third of children aged 5–14 years are overweight or obese (and one in ten is obese), with higher rates in Māori and Pacific children (Ministry of Health 2003b). So given there are around 60,000 children in any one age group, the proposed process of collecting BMI in a single age cohort would identify 20,000 overweight and obese children, 7000 of whom would be obese. At present paediatric obesity intervention services and programmes are significantly limited, both by locality and in terms of the numbers they can effectively treat with current resources and staffing. There is certainly not the scope to respond adequately to the potential additional 7000 children that would be identified by this annual process, let alone the true numbers of children and adolescents with obesity. Equally importantly, most of the current programmes are yet to be evaluated, so their efficacy as an intervention is unknown. This raises the ethical concern of referring children to a programme with uncertain effectiveness.

In the early stages of implementing the population collection of BMI it would not be appropriate to offer clinical interventions for those identified as overweight and obese. Instead, every child should be provided with information on healthy eating and activity, along with the suggestion of attending their local primary care team if they have any concerns about their weight or health. It would be better to confine the scope of the project to its primary purpose, which is to monitor population obesity rates by applying this systems indicator. The publishing of the resulting data could spur DHBs and PHOs to expand local initiatives and fully implement the principles of HEHA. At a later stage, when further programmes are established, evaluated and better resourced, the issue of the obligation to intervene can be revisited.

## Summary and recommendations

Considering the issue of consent, under the HIPC, for the purpose of obtaining health information such as an individual's height and weight for BMI, only awareness rather than formal consent is required (Office of the Privacy Commissioner 1994). As per the Marlborough experience an appropriate and feasible method would be to provide information to all families (eg, by a newsletter) to allow them the opportunity to discuss the process further and then at the time of measuring obtain verbal consent from each child.

Policy will need to be written to cover the privacy issues concerning the process of collection, collation and storage of the data. While the data needs to be secure it must be stored in a manner that allows its optimal usefulness.

The potential psychosocial risks of the measuring process can be minimised by measuring children in private and in a manner that is sensitive, supportive and respectful.

Regarding the issue of providing feedback to children and their families the lower risk option is to not give out the results or their interpretation. The provision of feedback could be a useful health promoting opportunity and impetus for change for families, but is not the part of the primary goal of this paper's proposal. For the process of providing feedback to be considered safe as well as useful, several requirements would need to be met.

Similarly there is no obligation to intervene to provide intervention or referral at an individual level under this current proposal. The purpose of this paper's proposal is to take a population approach to the prevention and management of childhood obesity. There still remains an obligation for clinicians, primary health care providers and DHBs to implement appropriate strategies in the prevention and provide intervention advice and programmes for their patients.

## 4 Practical Issues

The practicalities of collecting BMI at a population level need attention, focusing on the following key areas:

- setting – school or primary health care
- personnel – skills and training requirements
- data collection – protocols, equipment and collation.

### Setting

The two most practical and logical sites to consider for collecting BMI are the school and the primary health care practice. Both have their advantages and disadvantages.

### School

There are significant advantages in using the school setting for the population collection of BMI. The access to children and ease of collection in the school setting are far superior to what could be achieved in a primary health setting, even with opportunistic measuring and additional recall systems. Even with an average absentee rate of 7% (in primary and intermediate schoolchildren) and the exclusion of the minority of children who are currently home-schooled (less than 1%), there is the potential to achieve high coverage of BMI collection (Ministry of Education – personal communication). Several experts who have experience in conducting large-scale studies in childhood obesity by collecting anthropometric measures in Australia and New Zealand agree that school is the best place for population collection of BMI (Graham, Hofman and Swinburn – personal communication).

Currently, the Project Energize programme in Waikato has commenced its first phase and public health nurses are taking anthropometric measures and fitness assessments on all consented 5- and 10-year-olds in each study school (Graham – personal communication). They are able to assess all children at a large school in one day, and they have significantly more measures to take than just height and weight for BMI. The main barrier identified by the researchers is consent rates.

A Texan research group successfully implemented a childhood obesity surveillance system to monitor trends in BMI in school-aged children at the state level (Hoelscher et al 2004). They concluded that such a surveillance system was feasible and could be administered through school-based measurements.

Some schools have on-site health professionals, usually a school nurse, but no data has been collected on the extent of this provision and it is assumed to be patchy at best (Ministry of Education – personal communication). However, all schools have access to a public health nurse. At 11 years all children are both screened for vision problems and offered the 11-year-old vaccination (IPV and Td). Public health nurses administer the 11-year-old vaccination, and hearing–vision technicians conduct the vision screening, both in the school setting. Potentially both these established health contacts are opportune times when children could also be measured (height and weight). The additional time taken to measure children (less than a few minutes each) and the

corresponding cost would be minimised if associated with an established health contact. By linking this process to an established health visit in schools, the additional interruption to the curriculum would also be minimised and therefore would be more likely to be supported by schools.

### **Primary health care**

There are advantages to collecting BMI in a primary health care setting. Those taking part would have a direct responsibility for acting on the results, and PHOs may be more likely to initiate improved services to prevent and manage childhood obesity if they were involved in the collection and collation of their population BMI data.

If primary care practices were chosen as the setting for measuring and determining BMI, a practice nurse or other health worker could measure children opportunistically when they attended for other purposes (to a maximum of every six months). This would take a few additional minutes, and would be in keeping with the American Academy of Paediatrics (AAP) guidelines, which recommend annual measures of height and weight for all children, and subsequent calculation and plotting of BMI (Krebs et al 2003). Individualised growth charts, either paper based or on a computer programme, represent an important opportunity for engaging with the family.

However, this opportunistic approach is likely to be patchy, slow and have low rates of coverage. If coverage is low, it is likely the children measured will not be representative of the population, with children who don't attend their PHO for various reasons (including health status, access, and socioeconomic factors such as cost of visit and transport) under-represented. This incomplete data collection would make the results lack validity. Improving the rates of measuring would be a time consuming and expensive process, and is likely to be hampered by difficulties, including transport, tracking children and compliance. Primary health care providers are already under significant time, work and financial pressures, and they may be reluctant or simply unable to take on this additional health surveillance task. Even in the ideal PHO set-up it is unlikely the same rates of measuring could be achieved as could be achieved easily in the school setting.

However, the 'future PHO' could take on this responsibility provided full primary care enrolment, a fully integrated patient management system (PMS), an expanded Wellchild–Tamariki Ora schedule with agreed data points, and a commitment to complete acquisition of data, comprehensive training of primary care providers to include collecting this data, and a predetermined well-resourced referral pathway (Graham – personal communication).

## Personnel

If the school setting is chosen as the best site for collecting BMI, with only patchy provision of health care professionals in schools the local public health team are well suited to carry out the role of measuring children. Alternatively, a purpose-trained team could be employed for this annual process, which would be more cost effective. Again, if, as previously suggested, the 10–11 years age group is chosen as the best age to collect population BMI, then the measuring process could be linked to the year 7 school immunisation or vision screening.

The year 7 (form 1) immunisation programme involves groups of public health nurses visiting schools and vaccinating all previously consented children. The standard consent form that is completed by a child's parent/caregiver contains demographic information including ethnicity, gender, date of birth, school, address and GP. Currently around two-thirds of year 7 children are vaccinated through the school immunisation programme, with the remainder either being vaccinated by their primary health care provider or refusing vaccination. For larger schools, delivering vaccines to all consented year 7 students may take around half a day. The potential additional task of measuring all year 7 children was predicted by several public health nurses to increase the time the public health teams will need to spend at schools by 2–3 times.

The year 7 vision screening involves hearing–vision technicians testing all children's distant visual acuity and boys their colour vision. The Marlborough public health unit's measuring of year 7 students was done in conjunction with their vision screening (McMath – personal communication). It involved a public health promoter attending the school with the hearing–vision technician, with portable equipment, to measure the children's heights and weights. As the year 7 immunisation programme is incomplete, with some children being previously immunised by their GP and others refusing, it may be preferable to link the measuring of children to the vision screening, which is universal (McMath – personal communication). Also, as some children find the immunisation process stressful, the vision screening timing may also be preferable for this reason.

All personnel undertaking a programme to measure height and weight in children will need appropriate training and ongoing quality control to ensure minimal inter- and intra-measurer variability in measuring. Standardised protocols similar to those used in the Project Energize research project will need to be followed to ensure potential errors are minimised (Graham 2004). If the option of providing feedback to children and their families is chosen, then measurers will need additional training in counselling skills, with emphasis on appropriate terminology, cultural sensitivity and support, and nutrition, physical activity and health promotion.

If primary care practices were chosen as the setting for measuring and determining BMI, a practice nurse or other health worker would measure children opportunistically. This would take a few additional minutes and is part of good primary care. As with public health nurses, similar training, monitoring and protocols would be required.

A collaborative effort whereby PHOs and public health work together to collect BMI in children in schools may be a good alternative to an either/or situation. Involving the PHO in the process of collecting BMI of children within their area would encourage a local response by the PHO in terms of support or development of obesity management and/or prevention programmes.

## **Data collection**

The procedure of measuring children needs standardised equipment and protocols.

### **Equipment**

To measure BMI in schools, portable equipment will be required: for height a portable stadiometer, and for weight a standardised electronic scale. Scales will need to be calibrated regularly. Both a stadiometer and scales (possibly not electronic) would already be available in a PHO setting.

### **Protocols**

Protocols will need to be developed for introducing and discussing the procedure, taking the measurements and documentation. Children will need to be put at ease, have an understanding of what is to happen and why, and be measured in a way that preserves their dignity and privacy.

The procedure for measuring will require protocols including the removal of footwear and heavy outer clothing, positioning the child and using the stadiometer correctly. Measurements should be taken to the nearest 0.1 kg for weight and 0.1 cm for height.

The measurements could be entered onto a card that contains other demographic information about the child. If the measuring process is linked to the year seven immunisation, then, as previously mentioned, the consent cards will contain details such as school, date of birth, gender, ethnicity and GP if completely filled out by the parent/caregiver. Those not receiving the vaccine will also need similar information collected. Completeness of this information will need to be strongly encouraged and worked towards. If information on a child or children is incomplete, there need to be alternative processes in place to obtain the data, either from the parents/caregivers or the school enrolment. There are potential difficulties around collecting ethnicity data when children are identified as belonging to more than one ethnic group, and this needs to be standardised with current Statistics New Zealand practice (Ajwani et al 2003; Hofman – personal communication).

## **Collating information to a database**

Once height and weight are collected, the measurements and the calculated BMI can be entered into a database along with the demographic information. The potential exists to utilise the Kidslink register, which is also used as the basis for the National Immunisation Register. Policy will need to be written covering the privacy and storage of this information. If the information is entered without any identifying features other than the school and GP or PHO, then there is less concern in terms of the database storage (Harding – personal communication). However, this could make the data less useful in terms of analysis and future monitoring of children. More useful would be a database using identifiable data that is secure and encrypted, and therefore only accessible via strict processes, including ethics approval.

## **Summary and recommendations**

From the above analysis of the advantages and disadvantages of the main candidates for measurement setting, the school turns out to be the most practical and effective option when compared to the PHO setting. There is better potential to achieve high coverage, and with the suggested linkage to an established health contact in year 7 the process could be more efficient, cost-effective and supported by schools.

All personnel undertaking a programme to measure height and weight in children will need appropriate training and ongoing quality control. Public health teams seem an obvious choice, especially with their established health visit in schools to administer the year seven vaccination, or linked with the vision–hearing technicians visit in the same year. However, a purpose-trained team could be employed to undertake this annual task, and potentially this would be a more cost-effective option. There may be a small advantage to the process being linked with the vision screening rather than the immunisation, as the vision screening is universal and not associated with the same potential distress that is sometimes associated with immunisation delivery.

A collaborative effort where PHOs and public health nurses work together to collect BMI in children in schools may have its advantages. By involving the PHO in the process of collecting BMI in children in their area, the PHO may be more encouraged to respond in terms of supporting or developing initiatives to prevent and manage childhood obesity.

Protocols and standardised portable equipment will be required. Data, including the calculated BMI and demographic information, will need to be entered onto a database. Policy will need to be written covering the issue of the privacy and storage of this information. A database would be more useful if identifiable data is used, but this will require it to be secure and possibly encrypted, so that it is only accessible via strict processes including ethics approval.

## **5 The Outcomes of Monitoring Childhood Obesity using BMI**

The overall outcome we are aiming to achieve by introducing a systems performance indicator of obesity is a reduction in the prevalence of childhood obesity, adult obesity and the associated chronic disease burden. Research (tracking data and reversal of disease) would support the premise that a reduction in childhood obesity would have the long-term outcome of a reduction in adult obesity and its related chronic diseases, CVD and type 2 diabetes.

In Section 1 of this paper an analysis of candidate indicators of obesity showed that BMI is the single best potential population indicator for monitoring trends and interventions. We then carried out further evaluation of BMI in terms of its operational feasibility, usefulness, appropriateness, and the costs and benefits of using it to monitor the population, and the effectiveness of strategies and interventions to prevent and manage childhood obesity. Having established that BMI constitutes a viable indicator for measuring obesity in children, in this next section we look at the potential contribution that such monitoring could make to the overall goal of a reduction in childhood obesity. This analysis will use research when available, and expert opinion and existing practice where it is not.

To reduce the prevalence and impact of childhood obesity requires preventive strategies, early identification and appropriate management, strategies to improve adherence, and appropriate monitoring. For some populations at high risk of obesity, cultural targeting and setting appropriate approaches may be required. With a paucity of evidence-based weight management preventive and intervention programmes in New Zealand populations, there is much scope for new and innovative programmes to be developed. There are some notable examples already under way in South Auckland (the Kids in Action obesity management programme) and in Waikato (the preventive school-based Project Energize (Graham and Percival – personal communication).

### **The Primary Health Care Strategy**

The vision behind the Primary Health Care Strategy (2001) is for people to be part of local primary health care services that improve their health, keep them well, are accessible and co-ordinate their ongoing care (Ministry of Health 2001b). Primary health care services will focus on better health for a population, and actively work to reduce health inequalities between different population groups.

The vision involves a new direction for primary health care, with a greater emphasis on population health and the role of the community, health promotion and preventive care, the need to involve a range of professionals, and the advantages of funding based on population needs rather than fees for service. The Strategy aims to achieve this by:

- working with local communities and enrolled populations
- identifying and removing health inequalities
- offering access to comprehensive services to improve, maintain and restore people's health
- co-ordinating care across service areas
- developing the primary health care workforce
- continuously improving quality using good information.

The vision and the new directions will involve moving to a system where services are organised around the needs of a defined group of people. Primary health organisations (PHOs) will be the local structures to achieve this.

With the anticipated shift in focus of primary care to a population health approach, health promotion and disease prevention, we envisage PHOs taking on new initiatives to tackle obesity prevention, improve nutrition and physical activity. This would involve a multidisciplinary team approach, with perhaps practice nurses or dieticians taking lead roles in the delivery of prevention and intervention programmes targeting childhood obesity and overweight. All PHOs are entitled to health promotion funding where principles of the Healthy Eating Healthy Action (HEHA) strategy could be promoted (Ministry of Health 2004a).

### **Benefits of population BMI collection and measuring obesity**

There are several ways the population collection of BMI may contribute to the overall outcome of reducing childhood obesity and chronic disease. Because studies are limited in this area, most of the suggested benefits are based on existing practice and expert opinion. Where research or clinical experience is available to support the suggestions, this will be indicated.

Overall, the total population collection of childhood BMI would enable us to:

- obtain a richer set of data
- raise the profile of the prevalence and impact of childhood obesity
- influence health sector funding allocation and services directed at obesity prevention and management in childhood
- monitor the overall performance of the collective interventions
- potentially evaluate specific intervention programmes
- potentially use this as an indicator of DHB performance, and therefore measure DHB accountability.

## Obtain a richer set of data

Until the National Children's Nutrition Survey (NCNS 2002) there was no national data on the prevalence of child overweight and obesity in New Zealand (Ministry of Health 2003b). The NCNS 2002 was a cross-sectional population survey on a randomly selected sample of 3275 school-aged children (5–14 years) from 172 schools throughout the country. The goal was to select a nationally representative sample, although Māori and Pacific children were oversampled to achieve approximately equal numbers of Pacific, Māori and European/Other to enable ethnic-specific analysis. There are plans for repeated surveys of its kind, but it is not likely before 2010. In the 2002 survey, children of Asian descent were classified as European/Other despite their rapid population growth and increasing research to show their higher body fat and morbidity at any given BMI.

Collecting population BMI has the advantage of providing absolute numbers of children who are overweight or obese at a local (both DHB and PHO) and national level for the chosen age group. This would allow population monitoring of trends, subgroup analysis, and identification of high-risk areas. With population data collection there are no concerns of potential bias or applicability for the whole population, or any need to oversample certain population groups. By identifying high-risk groups or geographical areas, public and primary health care services will be able to develop improved, targeted and appropriate preventive and intervention strategies.

For some population groups, such as Pacific peoples, we already know the risk of overweight or obesity is around 60% by adolescence – at least one in every two Pacific children (Ministry of Health 2003b). From a public health viewpoint the predicted additional information provided by the population collection of BMI via a regular survey for Pacific children could be negligible. However, regular surveying would not have the sensitivity or capability to show changes or differences between subgroups of Pacific Island children, either by island group or geography, which population collection would. For example, if it is found that Pacific children living in west Auckland have lower rates, or a trend to reducing prevalence, of overweight and obesity compared to those living in south Auckland, then this would be a useful finding. Further analysis of why children are doing better, or how preventive, public and primary health care initiatives are working to improve the prevalence and impact of obesity, would be warranted. This 'appreciative enquiry' could then guide other PHOs or DHBs in terms of what services and interventions are more efficacious.

As stated in the Ministry of Health report *Our Health, Our Future*, the monitoring of population health outcomes allows historical trends to be tracked and inequalities among subgroups of the population to be identified (Ministry of Health 1999b). It would be possible to analyse the causal structure of these outcomes at multiple levels, including the social, cultural and economic determinants. Such analysis provides both explanations of observed trends and differences, and an evidence base for intervention. It could become a decision support tool to guide health and social policy. To enhance the usefulness of data, demographic information needs to be simultaneously collected, including ethnicity and an index of socioeconomic status.

Population collection will have the advantage of providing additional information about other minority ethnic groups, including Asian and Indian. It can identify communities where obesity is more or less prevalent, or where rates are improving or escalating. Based on the NCNS 2002 we can predict that the areas most likely to have high prevalence of childhood obesity are those with predominantly Māori, Pacific or low socioeconomic residents, such as south Auckland, Northland, the central North Island and Porirua. The population collection of BMI will allow this to be defined with more certainty and detail, to see differences in rural and urban areas, and to identify the PHOs, DHBs or schools catchment areas with the most significant burden of childhood obesity. Consequently, delivery of preventive and intervention services can be better targeted.

It will also identify those areas with low obesity prevalence, or where there is a positive trend in terms of a decline in prevalence over time. With the prevalence of childhood obesity increasing in New Zealand and worldwide, our initial success may well come in the form of halting the increase in prevalence, and PHOs or DHBs reporting static rates of obesity – as opposed to those with ongoing increases – may be regarded as doing well. Ideally, the aim is not only to halt the epidemic and rise in prevalence but to reverse it, although in the early stages of tackling this public health crisis small steps are all that can realistically be achieved.

Total population data is the gold standard in terms of measuring changes in population prevalence. Data will be maximally robust, without the usual concerns with surveys or studies of sample size and power, potential confounders and bias, and whether it is applicable to the wider population. Changing diagnostic criteria is cited as a contributing reason for variations in reported prevalence of some diseases without any real change in incidence (Stanley – personal communication). This can be avoided when defining childhood overweight and obesity if consistent BMI cut-offs are used and by using BMI as a continuous variable to calculate population or sub-population mean and distribution. As previously described, the internationally accepted BMI-for-age cut-offs (Cole charts) are recommended for epidemiological purposes, as were applied in the NCNS 2002 survey.

The data will be an ideal resource for researchers and policy analysts to use to measure the impact of public health promotion and specific interventions, as well as for DHB funders and planners to guide the allocation of funds and resources. With the detailed analysis possible from population collection of BMI, it will be a useful tool for forecasting the future need for services, particularly the predicted increase in adult obesity and the accompanying chronic disease burden.

## **Raise the profile of the prevalence and impact of childhood obesity**

Even though it is well established that New Zealand is included in the worldwide obesity epidemic, more could be achieved by continuing to raise the profile of the issue. The Ministry of Health's number one priority is primary health care, and the Primary Health Care Strategy's number one priority is chronic disease. But until everyone involved in the health and other government sectors, and other key non-government and private sector agencies, recognises the significance of this growing epidemic and supports interventions both strategically and financially, we will not be able to halt the growing obesity epidemic.

'Halting the rising prevalence of overweight and obesity in children is a public health priority' in the UK, according to the National Health Service plan (NHS Centre for Reviews and Dissemination 2002). The same is true in New Zealand, as outlined in the Healthy Eating Healthy Action (HEHA) strategy (2003) and implementation plan (2004) (Ministry of Health 2003, 2004a). HEHA brings together three related population health objectives from the New Zealand Health Strategy: improving nutrition, increasing physical activity and reducing obesity. The aim of the strategy is for the health sector to work in partnership with other government and non-government organisations, such as the food, recreation, sport and fitness industries, the media, the transport and education sectors and local government.

The regular population collection of BMI will provide an ongoing reminder of how significant this epidemic is for our children, which will hopefully result in the sectors and industries that have been poorly motivated to engage in the development and implementation of the national HEHA strategy being put under further pressure to participate. There should also be further public and media pressure for government, health and other sectors to act to curb the alarming trend.

## **Influence health sector funding allocation and services directed at obesity prevention and management in childhood**

With the raised profile of the prevalence and impact of childhood obesity nationally, there is the potential to influence Vote: Health funding directed at obesity prevention and management in childhood.

With the anticipated shift in focus of primary care to a population health approach we envisage PHOs taking on new initiatives to tackle obesity prevention, improve nutrition and increase physical activity. This is likely to involve a multidisciplinary team approach, with perhaps practice nurses or dietitians taking lead roles in the delivery of prevention and intervention programmes targeting childhood obesity and overweight. This means a shift in focus away from episodic care to population health and care across the continuum of disease; from prevention through health promotion and early identification, to management, ongoing support and improvement in adherence and self-management.

Literature from the USA, UK and Australia suggests that many primary care physicians and paediatricians do not feel competent to provide interventions for overweight children, adolescents or adults (Campbell et al 2000; Harvey et al 2002; Jelalian et al 2003; Story et al 2002). Perceived barriers to intervening include insufficient time, limited training in obesity management, limited high-quality information about effective management strategies, limited access to support and specialist services, and lack of motivation to work with these patients due to negative perceptions of overweight people or the efficacy of treatments. A US survey of paediatricians (primary health care providers for children in the USA), paediatric nurse practitioners and dieticians identified lack of parent involvement, patient motivation, support services, time and reimbursement, and treatment futility as the most frequent perceived barriers to obesity treatment (Story et al 2002).

The most common areas of perceived low proficiency in this survey were the use of behavioural management, guidance in parenting techniques and addressing family conflicts, and most practitioners expressed interest in additional training in obesity management. Across the disciplines the preferred method of training was professional guidelines (over 95%) and continuing medical education courses at local or national meetings (again over 90%).

A Cochrane systematic review (2002) of interventions to improve health professionals' management of obesity found it difficult to provide recommendations due to the heterogeneity and limited quality of the studies identified (Harvey et al 2002). However, the authors did suggest that reminder systems, brief training interventions, shared care and dietician-led treatments needed further investigation. There were insufficient studies on changes in the organisation of care (either the deliverer or the setting), and they suggested that further evaluation of organisational interventions was warranted.

One notable randomised control trial by Pritchard et al (1999) of a 12-month intervention in the primary care of adults compared those seen by a combination of doctor and dietician, and a dietician alone, with usual doctor care (Pritchard et al 1999). The drop-out rate was generally high, but better in the doctor/dietician group, although still 29%. Of the studies included in the Cochrane review, this study was the only one that assessed the cost-effectiveness of the intervention. On average the dietician group lost 5.1 kg at an additional cost of \$7.30 (Australian dollars in 1999) per kilo and the doctor/dietician group lost 6.1 kg at an additional cost of \$9.76 per kilo, compared to the control group, who gained 0.6 kg. This study showed the cost-effectiveness and usefulness of employing allied health professionals to facilitate or contribute to obesity management in the primary care setting.

In the future, with the potential development of registers through information technology such as Kidslink, records of a PHO's child population could lead to prompts for follow-up and monitoring for those identified as overweight or obese. These reminders could be both to the family and to the PHO team, and based on experience of other recall systems could improve long-term management of these children.

The raised profile of childhood obesity may encourage individuals and families to change their lifestyle behaviours to reduce obesity risk. It may also encourage other agencies and organisations such as schools, churches and local authorities to increase their role and commitment to reducing childhood obesity.

The experience in AIMHI (decile 1) high schools in South Auckland is a good example of how specific knowledge of obesity rates in a local environment (in this case the school) can be the stimulus to change (Woolston – personal communication). As part of the Adolescent Obesity and Diabetes Prevention Programme provided by the Diabetes Projects Trust and the NEW working party, and funded by the Counties–Manukau DHB, all year 9 students in AIMHI schools have a full assessment of their health and social needs, which includes measuring their BMI and blood pressure. Thus the prevalence of obesity for each school has been determined and this knowledge has led to a commitment by these schools, led by their principals, to improve the school nutrition environment and support interventions provided by the Diabetes Project Trust.

### **Monitor the overall performance of collective interventions**

If we were to rely on national surveys to monitor the progression of the obesity epidemic in our children, there would be at least an eight-year delay before this information became available. With the rate at which the prevalence of obesity is rising we cannot afford to wait eight years for feedback on our performance.

So far no country has a track record of attenuating or reversing the obesity epidemic (Swinburn et al 2004). Population monitoring is a vital part of a comprehensive strategy to reduce obesity. We need a robust and precise method to promptly assess the performance of our interventions. These interventions are wide ranging and include public health interventions and health promotion messages, environmental and transport factors, media, food pricing and availability, school- and community-based programmes, and primary health-care services. Annual collection of population BMI would be a useful, robust tool to monitor the overall performance of the collective interventions whose aim is to reduce overweight and obesity. Both the mean BMI and the proportion of children fitting the categories of overweight and obese could be monitored.

If the trends observed show further local and national acceleration in the growth of the epidemic, this would mean our collective strategies and interventions are not delivering the desired outcome of a reduction in obesity and its associated chronic diseases. This would require a review of local and national strategies and interventions in place, and, potentially, the implementation of new or modified interventions, ideally evidence-based as further research becomes available.

With population collection precisely defined, communities where the rates of obesity are increasing or decreasing can be identified. These communities may be defined by parameters including geography, decile, ethnicity, school catchment and church congregation. Where the rates of obesity are decreasing or stabilising, information can be gathered on the environmental factors, strategies and interventions that are likely to be influencing this positive trend, so that the information can be shared and applied to other similar communities. This analysis would imply an association but not prove cause and effect, which could only be done with high-quality controlled longitudinal studies (Graham – personal communication). Identifying the high-risk communities means we can better target effective strategies and programmes to the specific needs of those communities.

With information available annually, analysis and evaluation of current strategies and interventions can occur more rapidly, allowing a more prompt deployment of intervention programmes in areas of high need.

### **Potentially to evaluate specific intervention programmes**

Most intervention programmes have an evaluation component. However, the advantage of an overall monitoring system is that we can evaluate the impact of specific intervention programmes on a community's obesity rate. In order to assess the impact of a specific intervention on a specific population, usually a control population where the other important environmental, ethnic or socioeconomic factors are comparable is required.

Providing a well-controlled control population is likely to be methodologically difficult, however. An emerging research technique, referred to as 'action research', is used where there is minimal existing evidence around effective interventions but where action is still required due to the serious nature of the disease, as is the case with obesity (Holmes and Taylor – personal communication). Best available evidence will guide management initially, with subsequent randomisation to additional intervention strategies, and rapid evaluation. This action research can lead to rapid continuous improvement in the management of chronic diseases such as obesity.

Some programmes are financially constrained, and may therefore have a limited ability to evaluate their programme. At least the regular population collection of BMI would provide the potential for some indirect evaluation of these programmes.

### **Potentially as an indicator of DHB performance**

Currently DHBs report annually on childhood accountability indicators: low birth weight babies, breastfeeding-friendly hospital initiatives, ambulatory sensitive admissions and child oral health. For each accountability indicator DHBs are set annual achievable individualised targets. Childhood BMI could be introduced as an additional DHB indicator, either as a systems performance indicator or possibly as an accountability indicator. Concurrently, as part of the full implementation of the HEHA strategy, a qualitative indicator assessing DHB's implementation of HEHA principles could be introduced.

There are other mechanisms whereby DHBs report on various measures that can be used to make comparisons between DHBs, facilitate information sharing between the DHBs and identify areas that could be improved. Every six months each DHB provides data on rates of asthma re-admissions, gastroenteritis, teenage pregnancy, child injury and hearing, for example. Work is also been done on a potential benchmarking process to allow for more sharing of information between DHBs. This may be a more appropriate process to use for childhood BMI, in that, although DHBs would be compared, there would be no specific targets, but this would still allow information sharing between DHBs from those who have improving rates of childhood obesity to those doing less well.

The main driver of the obesity epidemic is the 'obesogenic environment', one that increasingly promotes a high-energy intake and sedentary behaviours. Most of the factors contributing to the rise in childhood obesity are out of the control – but not the influence – of the health sector and individual DHBs. For this reason, the potential introduction of childhood BMI as an indicator of DHB performance could be met with significant resistance. It could be seen as unhelpful and unrealistic to hold DHBs accountable for the extent of the childhood obesity burden in their catchment.

However, although many of the risk factors contributing to this growing epidemic are out of the control of DHBs, there is still scope for leading the way in preventive and intervention services. DHBs have an important role in:

- promoting breastfeeding and healthy eating
- promoting physical activity and reducing sedentary behaviours
- improving antenatal care
- providing opportunistic assessments and lifestyle advice
- promoting and supporting community- and PHO-led programmes
- advocating for changes to local community environments to improve the availability of safe areas for physical activity and play
- improving public transport and roads to encourage active transport to work and school
- improving access to healthy food choices in schools and communities.

Increased services, support, nutrition and activity advice are required for high-risk groups, including Pacific and Māori people, and families with parental obesity or family history of type 2 or gestational diabetes.

## **Summary and recommendations**

Population collection of BMI could contribute significantly to our overall goal to reduce the impact and prevalence of child and adolescent obesity. It would provide us with more detailed data and a more prompt and accurate method of monitoring obesity rates and interventions aimed at reducing obesity. Population data would provide a level of detail that could not be obtained by regular surveys or cross-sectional studies. It would enable us to identify communities or population groups where obesity is more prevalent or increasing, and – equally useful – those where it is less prevalent or reducing. This would assist in the analysis of what environmental and other influences contribute to positive and negative trends, and allow more appropriate targeting of resources and programmes. It would also provide information on ethnic minority groups such as Asian, Indian and Pacific Island groups that previously have not been assessed.

Finally, it would raise the profile of the extent of childhood obesity, which would be an additional spur for local authorities, DHBs, PHOs, schools and community groups, as well as government sectors and industry, to act.

## Conclusions and Recommendations

Obesity has reached epidemic proportions and is continuing to increase in New Zealand, as it is worldwide. Over half the adult population in New Zealand is already overweight or obese. Obesity is a significant modifiable risk factor for type 2 diabetes, cardiovascular disease, stroke and several common cancers. The prevalence of obesity is increasing as rapidly in childhood. The full health impact of the increased prevalence of childhood obesity will lead to an increase in adult obesity, the chronic disease burden and financial costs in the future unless action is taken to avert this trend. Obesity prevalence is disproportionately higher among Māori and Pacific ethnic groups, as is the prevalence of type 2 diabetes.

Action is needed to halt and then reverse the increase in overweight and obesity, and this includes strategies for both prevention and management of obesity. Although strong evidence for effective strategies to prevent and manage childhood obesity is lacking, the urgency of this escalating problem necessitates action based on the best available evidence. Ongoing evaluation is also required to allow rapid continuous improvement.

As with other non-communicable disease epidemics, obesity prevention and management require a comprehensive and intersectoral approach employing multiple strategies and interventions, as proposed in the HEHA strategy. Strategies and interventions will need to be sustained with a long-term view, and be applied at a range of levels, including the environment, the whole population, specific vulnerable population groups, and in both public and primary health care settings.

As part of a comprehensive strategy to prevent and manage obesity and its associated chronic diseases, a process of population monitoring is required. A system performance indicator is a tool that can monitor population trends, detect differences between groups within a population or over time, and assist forecasting future health service needs.

There are a number of potential direct benefits of monitoring obesity rates in childhood. Firstly, it will provide more detail about the trends in childhood obesity, with subgroup analysis by ethnicity, community, socioeconomic status, school, PHO or DHB possible. It would enable us to identify communities or population groups where obesity is more prevalent or increasing, and, equally useful, those where it is less prevalent or reducing. This would assist analysis of what environmental and other influences contribute to such positive and negative trends and allow more appropriate targeting of resources and programmes. By raising the profile and providing data about local obesity rates, the data could influence health sector funding allocations and services directed at obesity prevention and management. It would be a prompt and useful tool for monitoring the overall performance of collective interventions aimed at reducing obesity prevalence.

Of the candidate indicators of obesity in childhood, BMI seems the best available. The measurements of weight and height required to calculate BMI are reliable, reproducible and acceptable to subjects. Although not a perfect measure, BMI is a reasonable indicator of adiposity or body fatness. Gender- and age-specific international cut-offs for overweight and obesity for children aged 2–18 years are available. Trends in mean BMI, BMI distribution and percentage of overweight and obesity can be followed over time and used to identify differences within subgroups of the population, analyse the environmental and other influences contributing to the differences, and monitor interventions.

From the age-group analysis for measuring obesity at a population level, the age group that has the most advantages and least disadvantages is the 10–11 year-old age group. The main criteria used in this analysis were accessibility, prevalence of obesity and the subsequent increased ability to measure change, and the minimisation of potential harm. Children in year 7, aged 10–11 years, have an opportune time to undergo measurement associated with two established routine health contacts in the school environment, which would not create an additional interruption to the school curriculum. The prevalence of obesity at this age is moderate, and population monitoring at this stage (late childhood) has good potential for detecting change as a result of interventions upstream. Although some children in this age group are becoming more sensitive about their weight and the process of measuring could have a negative effect, if done well and in a routine manner the potential for harm can be minimised.

From the setting analysis for the collection of BMI, the school seems the more practical and effective option compared to the PHO. There is better potential for high coverage, and with the suggested linkage with an established health contact the process could be more efficient and cost-effective.

Potential barriers, risks and costs that need to be considered to implement the process of population monitoring include consent and privacy issues, minimisation of potential negative psychosocial effects and the consideration of the obligation to intervene.

From the analysis provided in this paper, the proposal of using childhood BMI as a systems indicator and tool to monitor population trends and to assess the effectiveness of interventions is both useful and feasible. It suggests that policy makers and funders and planners should consider implementing this indicator as part of an overall strategy to tackle obesity and chronic disease prevention and management.

To confirm the feasibility of this proposal, BMI collection in a few communities should be carried out. Of particular interest would be the assessment of whether the information obtained from the data about the local population was being used to influence funding allocation and services. As research evidence was lacking to support the premise that local knowledge would lead to local change in terms of funding and service provision, it would be useful for such a pilot to provide confirmation of this premise. Alternatively, a thorough evaluation of the established Marlborough programme of collecting BMI in all year 7 students, associated with the vision screening, could be undertaken to inform policy decisions.

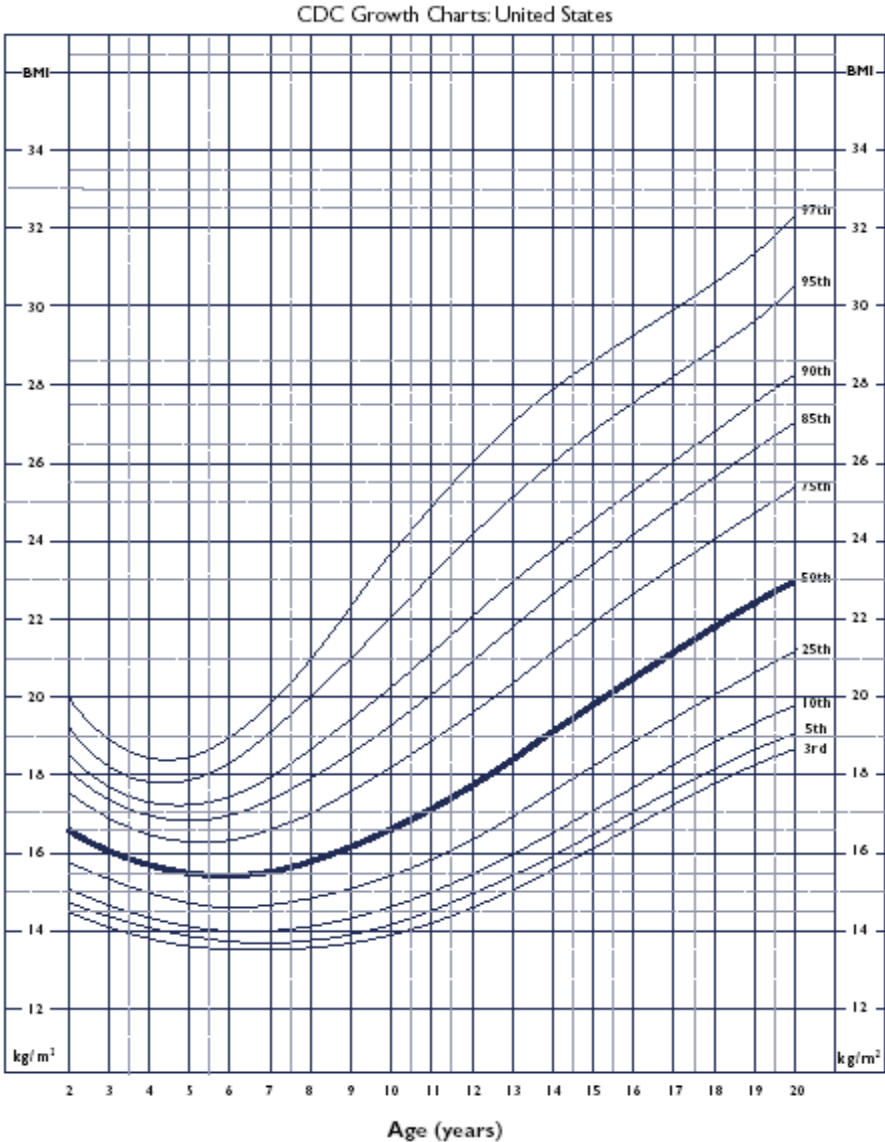
## Appendix 1: BMI Charts

**Table 2:** Calculation of overweight and obesity for ages 2–18, based on standard adult BMI

Age (years)	BMI equivalent to 25 in adult		BMI equivalent to 30 in adults	
	Males	Females	Males	Females
2	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.80	19.55
3	17.89	17.56	19.57	19.36
3.5	17.69	17.40	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24.00	24.11
10.5	20.20	20.29	24.57	24.77
11	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.70	29.41	26.69
17.5	24.73	24.85	29.70	29.84
18	25.00	25.00	30.00	30.00

Source: Cole et al (2000).

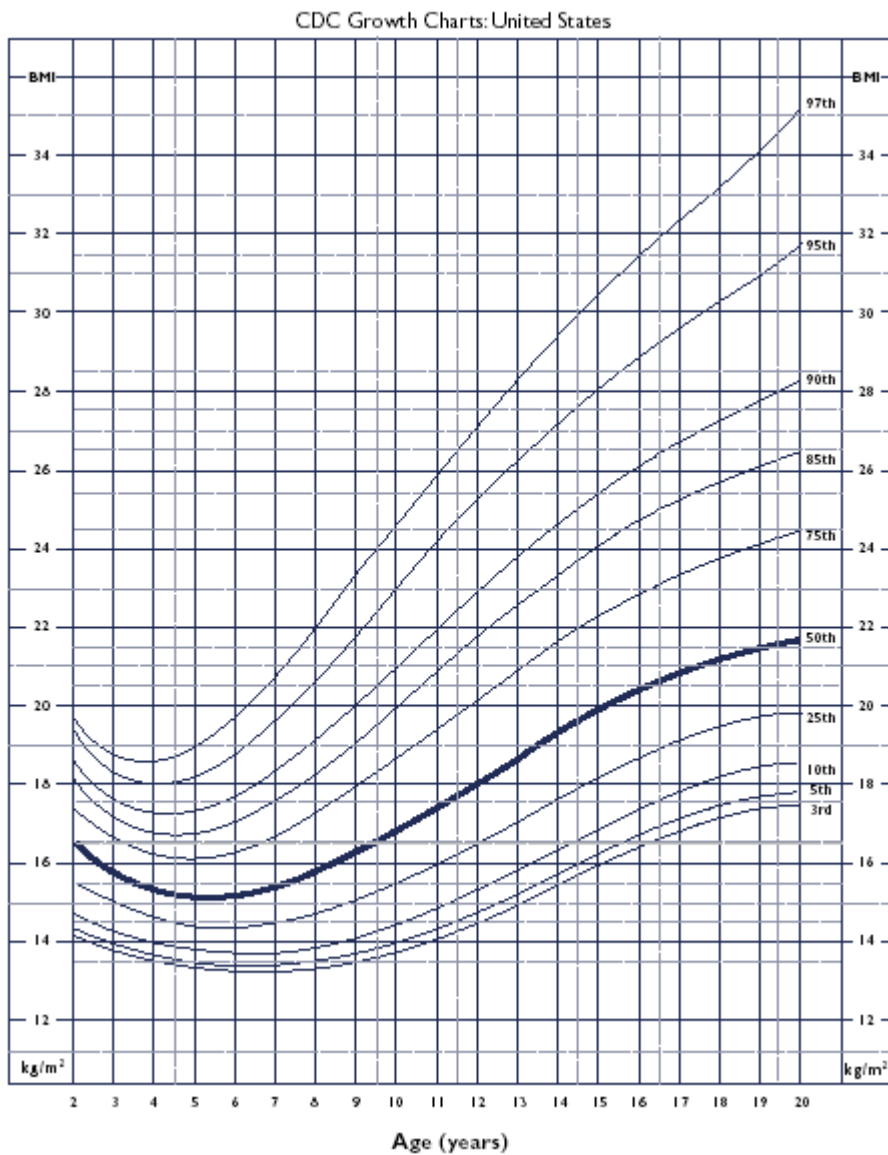
**Figure 2:** BMI-for-age percentiles: boys, 2 to 20 years



Published 30 May 2000.

Source: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

**Figure 3:** BMI-for-age percentiles: girls, 2 to 20 years



Published 30 May 2000.

Source: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

## Appendix 2: Screening

The proposed collection of BMI data and population monitoring of childhood obesity is not to be confused with a screening process. In the future the possibility of screening children to identify individuals for intervention may be revisited. Before this could occur, attention to the New Zealand screening assessment criteria, as set out in the National Health Committee's *Screening to Improve Health in New Zealand* would be required (National Health Committee on Health and Disability 2003). In our current health system several important criteria would not be met, including:

- an effective and accessible treatment for the condition identified through early detection
- high-quality evidence that a screening programme is effective at reducing mortality and morbidity
- a health care system capable of supporting all the necessary elements of the screening process, including diagnosis, follow-up and programme evaluation.

For a screening process, different criteria for deciding the most useful age would be required, as mentioned in section 2 'Timing of BMI Collection':

- the predictability of adult obesity
- the presence of modifiable lifestyle factors
- the potential responsiveness and adherence to interventions.

### Ages 5 to 6 years

If the role of screening in identifying obesity was thought to be useful, although the prevalence of obesity is low in this age group, success rates of family-based interventions are reported to be better in the 5–8 years age group. Their outcomes in terms of adherence, adoption of healthier lifestyle habits and improvements in weight measures are reasonable good. With the low predictability of obesity tracking through into adulthood in this age group, there are high rates of spontaneous track-down of obesity or overweight to normal weight, and therefore low potential overall gain in terms of reducing adult chronic disease from interventions targeting this age group.

Although school entry would seem an opportune time to measure children, associated with the well-child check or as a health screen on entering school, the prevalence of obesity and predictability of adult obesity is too low to support this. Tracking data shows obesity in this age group is not a strong indicator of adult obesity, with obesity status estimated to persist in only 20% of people.

Evidence from the NCNS 2002 showed 5–6-year-olds had the best nutritional status (physical activity levels and eating habits) of all the age groups, and therefore there is less need for any lifestyle interventions in this age group. Family-based intervention programmes have been found to have the best success rates in terms of adherence to the programme and the outcomes of both healthier lifestyle changes and weight measures in the age group (Mulvihill and Quigley 2003). These children are more influenced by their parents and more adaptable to positive lifestyle changes.

## **Ages 7 to 9 years**

For children in this age group the prevalence and predictability of adult obesity is moderate and they are still good candidates for intervention programmes. The NCNS 2002 showed some decline in healthy lifestyle behaviours in the 7–10 years age group, and therefore scope for modification by targeted interventions to maintain or improve lifestyle habits. Children in this age group are still reliant on their family for most of their lifestyle, food and activity behaviours, so interventions involving the whole family at this age have the potential to favourably change lifestyle behaviours that will be sustained.

## **Ages 10 to 11 years**

There is a further increase in prevalence of overweight and obesity in this age group, particularly in girls. The predictability of obese status tracking into adulthood is stronger, at somewhere between 47% at 7 years and 80% in adolescence. In this age group at least 30% of girls would have entered puberty, especially in Māori and Pacific young people. The increase in fat mass that goes with puberty results in higher rates of overweight observed in girls, again particularly Māori and Pacific girls.

The NCNS 2002 suggests there has been further decline in healthy lifestyle behaviour. At this age children are becoming more influenced by messages outside the family, especially their peer group. Though unlike adolescence, where it becomes very difficult to influence changes in behaviour favourably, there is still scope for positive family-based lifestyle interventions in children of this age group.

## **Adolescents**

The high predictability of persisting obesity status to adulthood is a supporting factor for screening in this age group. On the other hand, once obesity is established in adolescence it is more resistant to intervention (Barlow and Dietz 1998; NHS Centre for Reviews and Dissemination 1997). There is minimal evidence of effective intervention strategies altering health-related behaviours in adolescence. There is more research in the area of smoking than food or activity lifestyle factors, and the most effective strategies to reduce teenage smoking have been environmental, such as pricing and advertising (National Heart Forum 2003). A Cochrane review (1997) of treatment of obesity and overweight in children found evidence that family-based multi-faceted intervention programmes were effective in younger children but less so in adolescents, and suggested that a significant factor was that adolescents were less likely to comply with their parents' wishes (NHS Centre for Reviews and Dissemination 1997).

The NCNS 2002 found adolescents to have the worst nutritional status in terms of eating and activity habits, with high rates of skipped meals, significantly high rates of purchasing food from school canteens and consumption of sugary drinks, low consumption of fruit, marked decreased levels of physical activity, and marked increase in time spent in inactive pastimes. By this stage young people have established most of their health-related lifestyle habits and efforts to intervene are less likely to be successful.

## **Appendix 3: International Guidelines and Recommendations**

Australian guidelines: [www.obesityguidelines.gov.au](http://www.obesityguidelines.gov.au)

American Academy of Paediatrics recommendations: [www.aap.org/obesity](http://www.aap.org/obesity)

## Appendix 4: DHB Childhood Obesity Stocktake Report

Letters were sent out to all DHBs in April 2005, with reminder letters sent in June, requesting information on current and planned programmes for children and young people within the DHB area that address prevention or management of obesity, or aim to increase physical activity or improve nutrition. Replies were received from 20 of the 21 DHBs. To date no response has been received from Lakes DHB.

Spreadsheets for prevention programmes and treatment programmes were completed, with programmes classified by target age group, ethnicity and/or type of intervention.

Through the process of collating this information, research into obesity for other Ministry of Health work and attending various meetings and forums, it has become evident that the lists compiled by DHBs are incomplete. In several instances I have added additional programmes and interventions that are happening within a DHB catchment, which the DHB was either unaware of or did not think relevant. This raises the issue of the importance of a register at regional and possibly national level. This would allow useful information and resource sharing to collectively tackle the obesity problem more effectively.

Currently, Agencies for Nutrition Action (ANA), under the leadership of Christina McKerchar, through annual regional forums, national hui and fono, newsletters and the website provide opportunities for those working in the health, sport and nutrition sector to network, share and gain new information. They maintain a database of organisations involved in the promotion of nutrition and physical activity throughout New Zealand.<sup>4</sup> This shows there are more programmes and interventions targeting the prevention of obesity or the improvement in nutrition and physical exercise than programmes or initiatives targeting the treatment and management of obesity.

Dr Denise Barnfather, a public health registrar, has produced a summary of *Childhood Obesity Prevention Programmes in Auckland* (Barnfather 2004). Some of the notable programmes are described below, including the contact details (where available). The Children and Young Peoples Diabetes Prevention and Management Project, Auckland DHB have recently produced a compact pamphlet of services available for the prevention and management of childhood obesity, and their contact details, for the wider Auckland region. These have been sent out to all GPs in Auckland and are available for health practitioners working within the DHB on the ADHB hard drive.

### Treatment programmes and initiatives

From the literature there is evidence that *multi-faceted family-based programmes* that involve parents, increase physical activity, provide dietary education and target reductions in sedentary behaviour may be effective for weight management (NHS Centre for Reviews and Dissemination 2002). Only five DHBs had access to family-based, multi-faceted obesity treatment programmes:

<sup>4</sup> [www.ana.org.nz](http://www.ana.org.nz); phone 03 374 6909.

DHB	Programme	Provider	Contact
Northland	Lifestyle Clinic		
Auckland	Food with Attitude	Community Child Health and Disability Service	Fiona Smith, fsmith@adhb.govt.nz
Counties–Manukau	Kids in Action: Pacifika Challenge	South Seas Healthcare, TaPacifika PHO	Christina Tapu 09 278 2694
Waikato	Bodywise		
Nelson/Marlborough	Food with Attitude	Marlborough Public Health	

Evaluation undertaken in the Kids in Action programme for 2003 found that of the children who completed more than two weeks in the programme (n = 63), 70% maintained or lost weight and 42% lost weight. The Food with Attitude programme in Auckland has been incompletely evaluated, with findings of improved symptoms and confidence levels.

### Green Prescriptions (GRx) Active Families

In 2003/04 SPARC funded three regional sports trusts (Auckland, Waikato and Tasman) to deliver green prescriptions, which involve the prescribing of a physical activity programme to children and youth who are at risk of suffering adverse health affects from being overweight or obese. The programmes provided have varied across the country, but usually take referrals for 8–13-year-olds. They usually involve an individualised assessment and physical activity programme, a weekly group activity and educational workshops on nutrition and health, regular follow-up, support and monitoring over 6–12 months, and long-term strategies to maintain physical activity at exit, including involving the family and assessing options in the community.

Green prescriptions in children are yet to be fully evaluated. Despite this, the programme has been expanded to include three further sports trusts, Hawke's Bay, Harbour and Canterbury for 2004/05, with evaluation built in to the Canterbury programme (which will be catering for children aged 18 months upwards). Contact: Diana O'Neill, SPARC (diana.oneill@sparc.org.nz).

### Screening

Screening of preschool or school-aged children was reported to be occurring in five centres:

- Auckland: Early Childhood Health team, CCH and DS: pilot programme screening well child clients at three and four years of age.
- Waikato: Fit 4 Schools (Waikato PHO): comprehensive four-year-old check by GP team (training of practice nurses) linked to four-year immunisation (weight, height, BMI). Referrals are made for overweight/obese children. It started in May, in Raglan, Otorohanga and Te Kuiti.
- Waikato: also part of the Project Energize, a large longitudinal study evaluating a community/school programme to improve nutrition and increase activity in Waikato children. (See 'Prevention programmes', below.)

- Marlborough: public health measured BMI in all year 7 students in the Marlborough district, linked with the vision screening in 2002 and 2004.
- West Coast: five-year health checks on school entry. If weight is an issue: plan of action and in some cases referral to dietician.
- South Canterbury: a school entrant 'at risk' programme, public health nurse assessment, includes a BMI measure of children at risk. Parents are given resource material and in some cases referred for a dietician consult. This is intended to expand in 2005, to measure BMI in all children years 1 to 8, with annual monitoring in conjunction with Health Promoting Schools.

### **Train the trainer**

In five DHBs (Northland, Counties–Manukau, Capital and Coast, Hutt Valley and South Canterbury) there are various programmes usually involving a dietician upskilling health professionals (include public health nurses, PHO and practice staff) and teachers to provide good nutritional advice and diabetes prevention. The Diabetes Projects Trust, in conjunction with the Ministry of Health and Auckland Public Health, has developed a seven-hour course, funded by the Ministry. Contacts: Kate Smallman or Helen Gibbs, 09 273 9650 or [dptlifestyle@xtra.co.nz](mailto:dptlifestyle@xtra.co.nz) or [www.diabetesprojectstrust.org.nz](http://www.diabetesprojectstrust.org.nz).

### **Prevention programmes**

There is some evidence that multi-faceted school-based programmes that promote physical activity, the modification of dietary intake, modification of school meals and tuck shops and reduction of sedentary behaviours may help to reduce obesity in children, particularly girls (Mulvihill and Quigley 2003; NHS Centre for Reviews and Dissemination 2002). These need to target all children to avoid the stigmatisation of obese children (Ebbeling et al 2002). To date no childhood obesity prevention programmes have been evaluated in New Zealand populations. There is recent evidence from a UK study that a targeted, school-based education programme designed to reduce soft drink consumption in primary school children can reduce the prevalence of obesity (James et al 2004).

Several major projects incorporating childhood obesity prevention are being undertaken over the next few years:

- Waitemata DHB Wellbeing Schools' Project
- OPIC study, University of Auckland (and others)
- Children and Young Peoples Diabetes Prevention and Management Project, Auckland DHB (plus sponsors: Telecom and Skycity)
- Adolescent Obesity and Diabetes Prevention Programme, Counties–Manukau DHB with the Diabetes Projects Trust
- Project Energize, Waikato DHB.

These are described briefly below.

### **Waitemata DHB Wellbeing Schools' Project**

This is a proposed collaborative model for schools in Waitemata that aims to improve nutrition and physical activity, and prevent an increase in obesity prevalence. It uses a three-tiered approach to interventions, similar to the Tipu Ka Rea three-level approach introduced by Counties Manukau DHB (Kidz First) as a framework for developing Health Promoting Schools in a sustainable way. Other groups involved in the delivery of this project are Harbour Sport, the National Heart Foundation, School Food Programme, Team Solutions (Auckland College of Education) and the North Shore City Council.

### **Pacific OPIC study**

Obesity Prevention in Communities (OPIC) is being carried out in Fiji, Tonga, New Zealand and Australia by Professor Robert Scragg, Professor Boyd Swinburn, Dr Jan Pryor and Dr Sitaleki Finau. The research will involve a series of analytical and intervention studies in young populations in Fiji, Tonga, New Zealand and Australia to determine the overall impact of intervention programmes on the prevalence of obesity in young populations. This will include study of the feasibility of intervention components, sociocultural factors that promote obesity, and the effects of food-related policies and policy changes in Fiji and Tonga on the supply of foods that may affect obesity prevalence. The analytical studies will inform interventions and provide vital information on the sociocultural, policy and economic aspects of childhood obesity.

The host institutions for the research are the University of Auckland and Deakin University (Victoria, Australia). The budget (NZ \$2.86 million over five years) for the New Zealand component of the research, allocated by the Health Research Council, was matched by a similar allocation from the Wellcome Trust to the Fiji School of Medicine. The New Zealand intervention will be applied to Mangere secondary schools (8) and Mangere churches (26), mainly Pacific peoples. Students in years 9 to 12 will have assessments of their diet and physical activity, plus measures of BMI, abdominal circumference and bioelectrical impedance analysis (BIA), and school environments will be audited.

Further information: [http://www.deakin.edu.au/dhs/sentinel\\_site/opic/opic.htm](http://www.deakin.edu.au/dhs/sentinel_site/opic/opic.htm).

### **Children and Young Peoples Diabetes Prevention and Management Project**

This is a two-year project which aims to provide a management model for diabetes and obesity prevention and care for children and young people within a community framework, using a population-based approach. Interventions include creating a database of educational and health promotion resources; training, collaboration and strengthening of NGOs, PHOs and community groups; creating an 0800 line; and supporting community-based research.

Project Manager: Wendy Cook, ph: 09 307 4949 ext 23-464.

## **Adolescent Obesity and Diabetes Prevention Programme**

The experience of the AIMHI (Achievement in Multicultural High Schools – decile 1 schools) project in South Auckland is a good example of how specific knowledge of obesity rates in a local environment. In this case the school can be the stimulus for change. As part of the Adolescent Obesity and Diabetes Prevention Programme provided by the Diabetes Projects Trust and the NEW (Nutrition Exercise Weight) working party, and funded by the Counties Manukau DHB, all year 9 students in AIMHI schools have a full assessment of their health and social needs, which includes measuring their BMI and blood pressure. As a result, the prevalence of obesity for each school has been determined, and this knowledge has led to a commitment by these schools (led by their principals) to improve the school environment (eg, removal of vending machines, healthy tuck shops and lunchtime physical activity classes, such as hip-hop) and support interventions provided by the Diabetes Project Trust. A more intensive programme is delivered to three schools: Mangere, Southern Cross and Sir Edmond College.

Contacts: Jude Woolston, Counties–Manukau DHB (09 262 9538)  
Kate Smallman, Diabetes Projects Trust

## **Project Energize**

This is a longitudinal study to measure the effectiveness of school-based interventions to improve nutrition and promote physical activity, with long-term outcome parameters including obesity (BMI, BIA, waist and arm circumferences), hypertension, oral health, fitness, asthma, school attendance and bone fracture rates to be measured.

Lead researcher: Dr David Graham, ph: 0274 521 989 or  
Grahamd@waikatodhb.govt.nz.

## **Strategies to implement HEHA (Healthy Eating – Healthy Action)**

Several DHBs have begun to incorporate the HEHA strategies/framework into their district annual plan.

- *Lets Beat Diabetes* is Counties Manukau DHB's five-year plan to prevent and manage type 2 diabetes in their region, with 10 action areas including enhancing well child services, developing a schools accord to support 'fit and healthy' schools, supporting primary care-based prevention and early interventions, and enabling vulnerable families to make healthy choices.
- *Action for Healthy Children in Nelson–Marlborough* is a planned prevention initiative, with the focus on implementing HEHA.

### **Walking school buses**

In conjunction with the Energy Efficiency and Conservation Authority and local authorities, over 240 walking school buses are in action nationwide, with over 3000 children getting to school by this method. Walking school buses are in operation in at least half of the DHB areas. Within the Auckland region the coverage is patchy with the areas of higher deprivation having fewer walking school buses. Grants are available (\$1500) for schools to assist with setting these up.

Further information: [Streetwise@eeca.govt.nz](mailto:Streetwise@eeca.govt.nz).

### **Health Promoting Schools**

Almost all areas have Health Promoting Schools within their area, assisted by their public health teams, and other government and non-government service providers. Initiatives taken within schools are variable and depend on the priorities identified by individual schools. It is difficult to know how many have initiatives related to exercise, nutrition and obesity prevention, although some have healthy canteen policies.

Further information: [www.hps.org.nz](http://www.hps.org.nz).

### **Preschool children**

Bay of Plenty DHB and public health Childhood Obesity Project and Kohanga Reo Nutrition Project aim to improve the health and nutrition in preschool centres.

### **Socioeconomically disadvantaged communities**

Examples of initiatives here include:

- Bay of Plenty: food security; environmental scan and working with communities to develop initiatives to support healthy food choices
- Taranaki: Bell Block community action project, a food bank project and Cook for Less Trust
- Wanganui: Whanganui Well-being Child Obesity Prevention pilot programme, for children aged 8–12 years in the Castlecliff area.

### **Food or milk provision in schools**

Examples include:

- Hawke's Bay: Milk in Schools Pilot to decile 1 primary schools
- Manukau City Council: the Food in Schools (FIS) programme, which provides healthy lunches and breakfasts to 40 schools (1355 children), including kohanga reo and early childhood centres, in Manukau.

## Summary

- There are a wide variety of initiatives to improve nutrition, physical activity and prevent obesity, but very few for the treatment and management of obesity. A few areas (Auckland, Northland, Waikato and Nelson) do have multi-faceted family-based intervention programmes, but those in the bigger centres are unlikely to be able to cater for the full burden of childhood obesity in their area with current funding and resources.
- Difficulty obtaining funding was highlighted as an issue for many programmes. This is despite the growing awareness of the significance of the obesity epidemic and the urgent need to act.
- Most programmes are not being evaluated. This is probably related in part to funding and staffing issues.
- There is limited co-ordination, collaboration or recognition of current initiatives within DHB catchments at a DHB level. A few DHBs have a more comprehensive, co-ordinated multi-sectoral strategic approach to obesity prevention, most notably Counties Manukau with their Let's Beat Diabetes plan.
- There is limited inter-DHB co-ordination or collaboration. As part of a comprehensive and effective collective strategy to prevent and manage obesity and its associated chronic diseases within the health sector, there needs to be a process of information sharing and appreciative inquiry. We need to build on what is working well.
- There is no single body responsible for overseeing implementation, collating outcomes and reviewing evidence.
- Our current environment is obesogenic – it promotes a high-energy intake and sedentary behaviours. Egger and Swinburn (1997) suggest that if the macro-environment remains obesogenic, obesity will become more prevalent and programmes aimed at influencing individual behaviour can be expected to have only a limited effect (Egger and Swinburn 1997). Experience from other epidemics such as smoking is that they have been controlled only after environmental factors have been modified. Therefore, reductions in the prevalence of obesity seem unlikely until the environments that facilitate its development are modified to support healthy lifestyles. This could involve environmental changes such as regulation of the food industry, healthy tuck shops, and removal of carbonated drink-vending machines in schools, reducing the fat content of fast food outlets, urban design to encourage active transport with safe walkways and cycle lanes, strategies to improve access to good nutrition in low-income families such as community gardens, and restrictions on the advertising of energy-dense, nutrient-poor foods to children. This underlines the need for an intersectoral approach, as outlined in the HEHA Implementation plan, and the role of all in the health sector to advocate for change.

- As stated in the WHO Global Strategy on Diet, Physical Activity and Health Strategies, reducing non-communicable diseases should be part of broader, comprehensive and co-ordinated public health efforts, with all partners – especially government – addressing many issues simultaneously (World Health Organization 2004). In terms of diet, all aspects of nutrition, including food security and support and promotion of exclusive breast-feeding to six months need to be addressed. Similarly, for physical activity, issues related to activity in work, home and school life, urban planning and transportation to promote safe active travel and access to leisure activities need to be addressed.

## Appendix 5: Estimated Costs of the Year 7 BMI Collection by Marlborough Public Health

The following information was kindly provided by Lorraine McMath, Health Promotion Co-ordinator, Nelson–Marlborough Public Health Unit.

Population:	566 children; most attend three large schools, with the remainder in smaller schools outside of Blenheim.	
Equipment:	Portable stadiometer \$180; electronic scales \$70.	
Time:	<p>Estimated 1½ minutes per child to measure height and weight.            Teacher has already explained the process, so this is just the measuring time. Total 15 hours, excluding travel time.</p> <p>All children measured in one week (40 hours, includes travel).            Data entry of height, weight, age and school in Excel programme (set up to calculate BMI) 30 seconds per child (five hours total).</p>	
Personnel:	<p>Health promoter \$15/hour (used in Marlborough programme).            Public health nurse \$25/hour.            Data entry \$20/hour.</p>	
Overall:	<p>Equipment (one-off) \$250            Measurer (40 hours) \$600–1000            Data entry (5 hours) \$100            Miscellaneous (eg, petrol) \$75</p> <hr/> <p>Total \$1000–1425 first year            \$750–1175 subsequent years</p> <p>Approximately \$2 per child.</p>	

## Appendix 6: Principles of Effective Interventions

The following are key principles of effective interventions in the management of childhood obesity as suggested by the literature reviewed while preparing this paper. It is clear that achieving sustainable weight loss or weight maintenance in children is difficult, and often the evidence for what works is weak at best. From the current literature it appears that multi-faceted family based programmes have the best outcomes. This list is not intended to be complete nor is it written in order of importance.

- motivated child and family
- family involvement
- involves parental skills and behaviour management
- achievable and sustainable lifestyle changes – small and incremental
- long-term focus
- well supported, moving towards self-monitoring
- professionals working with the child and family need to be encouraging, motivating and empathetic, not critical and judgemental
- main goal: a healthier lifestyle rather than weight or measure goals
- consistent key messages/components as per HEHA:
  - improving nutrition
  - reducing sedentary activity
  - increased physical activity/exercise.

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