International Journal of Pediatric Obesity. 2009; 4 (Suppl 3): 6–14

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Abstracts

WHY CHILDREN AND ADOLESCENTS OBESITY CHAIR?

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Obesity has risen to epidemic levels in various parts of the world. It causes devastating and costly health problems, reduces life expectancy, and is associated with stigma and discrimination. Recently, the impact of obesity on mortality has been presented as being nearly as important as that of cigarette smoking (1). Over 400 000 deaths in the US in 2000 (17 percent of all deaths) were related to poor diet and physical inactivity compared with 435 000 deaths related to tobacco use. While most of the major preventable causes of death showed declines or little change since 1990, deaths due to poor diet and physical inactivity increased 33 percent (2). Poor diet and physical inactivity may soon overtake tobacco as the leading cause of death.

In May 2004, the Fifty-seventh World Health Assembly adopted the Global Strategy on Diet, Physical Activity and Health (3). The Strategy includes recommendations for WHO and its Member States, international partners, non-governmental organizations and the private sector in combating the rise of non-communicable diseases through a healthier diet and increased physical activity. In different parts of the world, several steps in applying this strategy have been undertaken; unfortunately, this was not the case in the Arab world countries including Saudi Arabia, where no significant action plans were endorsed.

King Saud University (KSU) is one of the first institutions in the region and amongst the very few international Institutes that started a pediatric comprehensive weight management program including medical, behavioral and surgical interventions. Internationally, KSU is considered a leading center in providing bariatric surgeries for obese children and adolescents. Building on this unique experience, the university has established an Obesity Chair with a vision to make King Saud University a well-recognized international center for child and adolescent obesity research, prevention and intervention. The mission of the Chair is to help in reducing the incidence of obesity and related diseases through leadership in basic, clinical and epidemiological research. In addition, the chair aims on providing the best patient care, and public education in the field, and intends to train a new generation of Saudi researchers and physicians at the highest international standards. This will include a range of long-term strategies that involve an integrated, multi-sectoral, population-based approach with environmental support for healthy diets and regular physical activity. In collaboration with the Chair's international and national experts, we have an ambitious and unprecedented target to achieve within the next 4 years (4).

Key words: Obesity, pediatrics, children, adolescent, obesity chair

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"CHILDHOOD OBESITY": A GROWING THREAT TO PUBLIC HEALTH IN SAUDI ARABIA

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Saudi children and adolescents 15 years of age and younger constitute about 40% of the Saudi population (1). Early national Saudi medical literature referred to the existence of obesity and its health consequences as a feature of social affluence and economic prosperity (2,3,4). Unfortunately, the majority of reviewed studies were sporadic and did not represent the whole population. At the present time and until evidence-based conclusions can be reached regarding the exact prevalence of childhood obesity, the increasing demand on bariatric surgical interventions in Saudi Arabia could be an indication of the magnitude of the problem (5). The observation of obesity among school children has raised many concerns among educational and medical activists. Legislation has been implemented to restrict the purchase of junk food in school premises, and the consumption of fresh milk and dates as sources of energy and natural sweets were encouraged. The concept of adopting health promotion in schools was endorsed in different localities in Saudi Arabia; however, measurable outcomes of such actions are far from being recorded or have been completely evaluated (6). In an effort to exercise the epidemiological sense of the problem, a cross-sectional study including four private female primary schools in Riyadh city was conducted in 2007 and included about 1 072 students within the age group of 8 to 12 years. The majority belonged to above average socioeconomic status. The study revealed an almost 15% prevalence of obesity among surveyed students, who had limited instructional physical education in schools, thus supporting Hills' and Peters' conclusion since 1998 that "an acquired contribution to obesity depends largely on an environment that promotes excessive food intake and discourages physical activity" (7). The proportion of "obese" students significantly increased with age. It was cautiously concluded that "If this trend continues it can be alarming to the general status of health". The interest in studying the growing epidemic of childhood obesity was shared by many health professionals from various medical subspecialties; so they united to establish a scientific workforce to deal with the situation from various dimensions and in a multidisciplinary approach expressed in the formulation of the Obesity Research Chair at King Saud University in 2008\2009. Undergraduate medical students of King Saud University were consequently involved in being part of an investigating team applying the Global School-Based Student Health Survey (GSHS), which is concerned with promoting healthy lifestyle practices in selected schools in Riyadh in 2008 and 2009 (8). Additionally, school children were provided with typed cards recording their body mass indices and were taught to calculate them by themselves to improve their awareness and to keep track of their annual progress. The assumption that "public health is threatened by the existence of childhood obesity in Saudi Arabia" deserves to be investigated. Threats to the overall health of a community are generally based on population health analysis in terms of morbidity and mortality. The economic cost of obesity, with job loss and low productivity should also be considered. Additionally, a surveillance system is needed to assist health care leaders and decision makers on planning for the future.

Key words: Obesity, pediatrics, children, adolescent, public health, Saudi Arabia

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ISSN Print 1747-7166 ISSN Online 1747-7174
DOI: 10.1080/17477160903154953

ACCEPTING THE PROBLEM AS OUR OWN: CHILDHOOD OBESITY IN SAUDI ARABIA

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Obesity has become a pandemic with more than 1 billion subjects affected (1). Saudi Arabia as a country has a very young population with a current median age of 21 years, and based on a population census conducted in 2007, 57.31% of males and 55.51% of females are younger than 20 years of age (2). As the country matures there has been a shift of health problems from infectious diseases to more chronic health care problems, such as diabetes, hypertension, coronary artery disease and obesity. Obesity as a health care problem has been studied from different angles in Saudi Arabia, and in this paper we aim to systematically review epidemiological Saudi literature as it pertains to childhood obesity.

A systematic review of all original research papers pertaining to obesity in Saudi Arabia was undertaken through the Medline database. Search terms included: obesity, childhood and Saudi Arabia. Papers were eligible for entry if they were published in English in a peer reviewed journal, and included original data. We excluded papers that did not address prevalence, incidence or risk factors for childhood obesity.

The initial review yielded 221 articles, of which only 42 articles were eligible for consideration. The review of these articles revealed the following information:

1. Prevalence of obesity in Saudi Arabian children

A study from the Eastern Province of urban school children from the ages of 6–17 years showed a prevalence of overweight of 15.5% and obesity of 15.6%, which included 2 239 female students from the Al Khobar area (3). A study of Jeddah school children, aged 9–21 years, showed a prevalence of overweight of 13.4% and obesity of 13.5% (4). These numbers were also supported by studies from Riyadh of 702 male school children only, aged 6–14 years, with a prevalence of obesity of 24.5% (5). The lowest prevalence of obesity was noted in a study in the Southern Provinces of 2 696 boys, aged 11–19 years, with overweight and obesity of 16% (6). Of note, all of these studies were biased by either representing only urban areas, female or male or non-standardized groups. These shortcomings make generalizations of the results impossible.

Nationally, Al Hazmi studied national prevalence of overweight and obesity in children (7); he included 12 701 children, aged 1–18 years, from all regions of Saudi Arabia. His findings showed a prevalence of overweight ranging from 8.8–27.4% with an average of 10.68% in Saudi boys, and mean obesity being 5.98% in males; females who were overweight ranged from 9.3–27.6% across the Provinces, with the mean being 12.7%, and obesity ranging from 4.4–13.8% (mean was 6.74%). Moreover, the results from this national survey seemed to indicate some interesting trends where females and children residing in urban centers are more likely to be overweight or obese. Furthermore, the Eastern Province had the highest rate of obesity whilst children in the Southern Province were least likely to be obese.

2. Trends of obesity in Saudi Arabia

The overall trend of obesity prevalence seems to be increasing amongst Saudi children; at least four comparative studies have been published that addressed this issue. In a study done on school-aged girls in Al Khobar, the rate of obesity increased by 5% over a 4-year period from 28% to 33.2% (3,8). Likewise, Abalkhail studied children in Jeddah and was able to show an increase in prevalence over a 6-year period (9). Interestingly, Al Hazzaa showed an almost 8-fold increase over a 17-year period from 3.4% to 24.5% in the Riyadh area (5). Nationally, El Mozan studied the nutritional status of preschool children. Although there was a clear improvement in the nutritional status of Saudi children, the rate of overweight and obesity also increased (10).

3. Risk factors for childhood obesity

All epidemiological research on childhood obesity in Saudi Arabia is cross-sectional in nature making identifying predisposing factors for this disease difficult. Several temporal relationships have been identified; however, these include: parental work in a private sector and parental education, both of which can be surrogates of the socioeconomic status indicating that children from more affluent families tend to be more overweight. Moreover, physical inactivity and a family history have also been proposed as risk factors for the disease.

Finally, obesity is prevalent in Saudi Arabia across all regions within the Eastern Province showing a higher prevalence of overweight and obesity, and the Southern Province showing the lowest. Children from urban areas were more overweight and obese. There is an acute need for more systematic studies with more in-depth inquiries with regard to longitudinal trends of childhood obesity and contributing risk factors.

Key words: Obesity, pediatrics, children, adolescent, Saudi Arabia

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OBESITY IN SAUDI CHILDREN IN THE EASTERN PROVINCE OF SAUDI ARABIA

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During the end of the last century, obesity was identified as a worldwide health care problem that is affecting the well-being of the population, previously known in the adult population, but in reality, studies are reporting an increasing problem in children too (1). The Gulf region is not exempt.

Many surveys have reported the prevalence of overweight and obesity in Saudi children. All areas and provinces of the country have been affected through all ages (2,3). Governmental and local authorities have implemented education programs to help weight reduction or prevention. The abnormal weight in children is still considered by experts as an imbalance between diet and habit, although hormonal etiology in children is a diagnosis that should be ruled out first.

In order to add valid information about the status of weight imbalance and child weight status in our region, this study has been conducted in the Eastern Province of Saudi Arabia with the following objectives:

1. To determine the prevalence of overweight and obesity in children from the Eastern Province of Saudi Arabia and study its basic demographic distribution, and to compare it with the Gulf Countries and other areas of the world.
2. To compare the prevalence with Non-Saudi children living in Saudi Arabia.
3. To propose a prevention and treatment plan for overweight and obesity.

This study collected first 10 509 files, including 9 249 consultations done in OPD in Saad Specialist Hospital, from January to June 2006. After excluding follow-up consultations, repetitions and non-completed file data, a total of 7 497 files were enrolled in the study.

According to our study findings, 42% of Saudi children in the present Eastern Province sample have a BMI greater than the 85th percentile. It was evident that Saudi children start developing overweight when they are 5–9 years of age, and continue to increase up to their precious adolescent years. Twenty-one percent of children at 5–9 years are overweight and 21% are obese. This could be attributed to the fact that children start going to school at that age, and hence, there is poor control of eating habits and nutrition at this stage. Moreover, children have been less active; few, or none, of them walk to school, spending more time in sedentary entertainment activities, including television viewing, and playing computer and video games. On average, a child spends 6 hours per day in front of screens (4).

Our results agree with a previously published study in the country that obesity in both genders is lowest in pre-school children (31%), and highest among adolescents (50–76%) (2,5,6). In our sample, the peak of obesity starts at 10–13 years of age (28%) and keeps the same high prevalence at age 14–18 years. Studies have shown that 80% of obese adolescents become obese adults (7). Adolescence has been addressed as the "critical period for the development for adult obesity" (8). Hence, if intervention before this stage is unsuccessful, intervention at this age becomes vital for both future health and ability to sustain long term weight control.

We developed, in our institution, a plan of action for obesity prevention and detection (7). It is oriented towards the community in general and towards children particularly. In our opinion, prevention should start at birth by putting more emphasis on exclusively breast feeding for the first 6 months of age, and continue throughout school age with a special interest starting at the age of 10 years. Regarding screening for early detection and management of these cases, we propose a plan that is based on regular follow-up and supervision. Fifty percent of Saudi children from the Eastern Province in our sample have a body mass index (BMI) greater than the 85th percentile, being overweight or obese. Our study showed that obesity starts early in life (10–14 years), and continues all through the ages of adolescence. Prevalence of obesity is higher among males compared with females, who show a higher prevalence of overweight rather than obesity. Environmental factors seem to play more of an influence on the prevalence of obesity than do genetic factors, because there was no difference in obesity among Saudi and Non-Saudi children, as well as similar weight distribution between males and females in children below one year of age. It is difficult to reduce excessive weight once it becomes established. Children, therefore, should start prevention of obesity from birth by putting more emphasis on exclusively breast feeding for the first 6 months of life. It is becoming a priority to establish natural settings for pre-school, school and adolescent health programs with the emphasis on increasing physical educational hours, and incorporating health messages into school curricula. Integrated preventative measures, screening for early detection/management and educational programs towards a healthier lifestyle are required at the national level.

Key words: Obesity, pediatrics, children, adolescent, Eastern Province, Saudi Arabia

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CHILDHOOD OBESITY RESEARCH IN SAUDI ARABIA: WHERE ARE WE AND WHAT DO WE NEED?

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Obesity has become a pandemic and Saudi Arabia is no exception. Due to the significant social changes that took place over the past few decades in Saudi Arabia, there has been a surge in the prevalence of obesity in the Saudi population. It is estimated that the overall prevalence of obesity and overweight in Saudi children and adolescents is around 16.5% in boys versus 19.4 in girls (1). Furthermore, a clear increase in the prevalence of obesity has been documented in at least two local studies (2,3). As a result of this increasing public health problem a significant investment in research is needed to address all the challenges created by childhood obesity. Based on our review of the Saudi literature we aim here to suggest areas of need and potential significant impact from a public health standpoint that can act as research priorities for future childhood obesity research in Saudi Arabia.

Based on our systematic review of the literature, we have identified several limitations of the current published Saudi original research. This list of limitations is not fully applicable to all studies and we would readily acknowledge the significant amount of work that has been contributed by others. These limitations are: 1) Significant under-representation of certain areas of the Kingdom, such as the Northern region; 2) Bias towards large urban centers; 3) Prevalent convenience sampling and under-utilization of systematic sampling techniques, which would yield more representative study populations; 4) Prevalent cross-sectional study designs and lack of more in-depth analytic studies; 5) Some studies collected data via instruments that were not validated prior to usage, placing the yielded data in question; 6) Lack of population-based data that systematically surveys a defined population in a defined geographic area; and 7) Although all references based the definition of obesity on body mass index (BMI) there is a lack of accurate definition of which BMI method is used i.e., Institute of Medicine versus the Center for Disease Control.

Opportunities for public health-oriented childhood research in Saudi Arabia are well recognized. Saudi Arabia is a young country with children under 20 comprising around 57.31% for boys and 55.51% for girls of the whole population (4). This underscores a relatively large population that is at risk of this disease especially in view of the documented increasing prevalence. Furthermore, this also suggests that this young population would be amenable to longitudinal research that not only aims at decreasing risk factors in the study subjects but also to help study the impact of any intervention on their future offspring. We suggest the following list of research priorities that are acutely needed to address knowledge gaps in the understanding of childhood obesity in Saudi Arabia and internationally: 1) Systematic study of prevalence of overweight, obesity and behavioral variables in children and adolescents; 2) Longitudinal follow-up of the prevalence of weight and behavioral variables over time; 3) Longitudinal follow-up of the prevalence of weight and behavioral variables by country region with special attention to adequate representation of rural and urban centers; 4) Health service research aimed at assessing the quality of services offered to obese children or those at risk with predefined outcomes, such as the rate of initiation of the medical therapy, health education interventions, and the impact of creation of centers of excellence on health outcomes; 5) Collection of population-based data to avoid biased estimates of prevalence and incidence; and 6) Impact of obesity on the outcomes of concomitant disease, treatments, surgeries or injuries.

Finally, we are certain that our aforementioned list has significant omissions but we would hope that by publishing such a list we would serve two objectives: first, to start a dialogue in the country and our region relating to research priorities in childhood obesity and second, we would hope that such dialogue would empower our researchers to conduct more focused research that would potentially yield data that are representative, informative and generalizable to our region, this in turn, would bring us one step closer to interrupting this circle of increasing childhood obesity and would help us improve the effectiveness of preventative and therapeutic interventions of this disease.

Key words: Obesity, pediatrics, children, adolescent, Saudi Arabia, studies

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GENES AND OBESITY IN SAUDI ARABIA

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Our understanding of how and why obesity develops is incomplete, but involves the integration of social, behavioural, cultural, physiological, metabolic, and genetic factors. A predisposition to obesity has been linked to a number of candidate genes. Obesity and overweight are well-known risk factors for most chronic diseases, and are expected to be increasing in the Kingdom of Saudi Arabia. The increase in the prevalence of childhood obesity is also seen in developing countries. Obesity in 6–12-year-old children increased from 12.2% to 15.6% in the children of Saudi Arabia (1). A predisposition to obesity has been linked to a number of candidate genes. The most important gene is the *MC4R* gene, and mutation of this gene accounts for 5% of obesity in the population (2). In addition, screening for the mutation in the *MC4R* gene among different regions of Saudi Arabia is important. *MC4R* mutations constitute the most common monogenic form of human obesity (3). The prevalence of overweight and obesity in Saudi Arabia stands at 13.8% and 20.5%, respectively. No up-to-date cross-sectional survey and genetics screening study for genes involved in obesity has been taken on a Saudi population. Previously, I scanned for the *MC4R* mutation in a large unselected European British population and identified one novel mutation and 49 known mutations (Alharbi et al., 2005 and 2007). A predisposition to obesity has been linked to a number of candidate genes; those that are inherited as autosomal recessive, including leptin, the leptin receptor, prohormone convertase-1 and POMC. An autosomal dominant form of obesity is caused by mutation of the melanocortin-4 receptor (*MC4R*) gene; study on this mutation is focused on for many reasons: i) several mutations in *MC4R* in animals and humans predispose to morbid obesity; and ii) all the other known obesity genes are generally recessive (i.e., for the recessive genes, heterozygote parents with rare mutations are unaffected, whereas even 50% normal function leads to morbid obesity for *MC4R* mutations).

Key words: Obesity, pediatrics, children, adolescent, genes, Saudi Arabia

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THE Arg16Gly POLYMORPHISM IN THE β2-ADRENERGIC RECEPTOR GENE IS LINKED TO OBESITY AND HYPERTRIGLYCERIDEMIA IN SAUDIS

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The β2-adrenergic receptor (ADRB2) is a major lipolytic receptor in human fat cells, and several studies in different populations have shown an association between codon 16 polymorphism of the ADRB2 gene and obesity. In this study we conducted a case-control investigation to determine association between ADRB2 gene polymorphisms at codon 16 and obesity in Saudi individuals. The study included 329 non-related individuals (males: 109 [33.1%] and females: 220 [66.9%]), age ranging from 18 to 36 years. Anthropometric measurements were carried out and body mass index (BMI) was calculated. Metabolic parameters (glucose, triglyceride, cholesterol, high and low density lipoprotein [HDL- and LDL, respectively]-cholesterol, insulin and leptin) were determined using commercially available kits or autoanalysers. The Arg16Gly polymorphism was investigated in each individual by polymerase chain reaction (PCR) amplification of the DNA segment containing codon 16 of the ADRB2 gene, followed by DNA sequencing. The subjects were divided into three groups (normal weight, overweight and obese) according to BMI and the levels of the metabolic parameters and frequency of Arg16Gly polymorphism were obtained separately for each group. Overweight and obese subjects had a significantly higher frequency of Gly16 compared with normal weight subjects. The subjects carrying Gly16 allele regardless of BMI had greater total fat mass, waist and hip circumference, W/H ratio, cholesterol, triglyceride, low-density lipoprotein cholesterol and plasma leptin compared with those without the Gly16 allele. Our findings provide strong evidence that Arg16Gly polymorphism is associated with obesity in the Saudis and influences lipid phenotypes and leptin levels in overweight/obese subjects.

Key words: Obesity, pediatrics, children, adolescent, polymorphism, Saudi Arabia

PATHOPHYSIOLOGY OF OBESITY

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The ultimate obvious cause of obesity is an imbalance between caloric intake and energy expenditure resulting from a complex interaction of genetic, physiological, behavioral, and environmental factors (1). This simple notion does not explain the many factors that may influence body weight regulation. Recently, data have supported the correlation between exposure to infectious viruses, such as the human adenovirus-36, and the prevalence of obesity (2). These suggestions, as well as others, point to some unconventional factors that may influence body weight regulation.
In most people, appetite regulation appears to be the most important component in the pathophysiology of obesity. Briefly, it consists of 2-way communication between the central nervous system (primarily, the hypothalamus) and peripheral tissues (mainly the gut organs and adipose tissue).
The hypothalamus is the central processing unit that integrates the multiple inputs it receives from the bloodstream (e.g., leptin), peripheral nerves, such as gastric distension sending negative feedback to the hypothalamus via vagal afferents, and cortex (e.g., seeing, smelling, or tasting) (3).
A key element of the physiological system that regulates body weight is leptin, a hormone produced by adipose tissue that acts via the hypothalamus as a satiety signal to inhibit appetite (4,5). Obese, leptin-deficient rats injected with recombinant leptin ate less food and showed dramatic declines in body weight. Humans are more complicated. In some studies, obese human subjects were found to have high leptin levels, and yet these elevated levels did not result in reduced intake. One suggestion for this paradox is that humans are leptin resistant (4). Hence exogenous injections of leptin have not resulted in significant body weight reduction in humans. Genetic evidence indicates that leptin regulates energy balance by modulating the expression of both anorexigenic (appetite-suppressing) and orexigenic (appetite-stimulating) substances and binds their receptors in the hypothalamus. Low levels of leptin will stimulate the production of neuropeptide Y (NPY) and agouti-related peptide (AGRP), which are hypothalamic orexigenic peptides that serve to increase food intake and decrease energy expenditure. The expression of NPY mRNA is inhibited by leptin. Melanin-concentrating hormone (MCH) is another orexigenic neuropeptide that is increased when in a fasting state or when there is a leptin deficiency. Adequate leptin levels stimulate the encoding of the anorexigenic peptide, α-melanocyte-stimulation hormone (α-MSH), which is derived from pro-opiomelanocortin (POMC). The neuropeptide α-MSH is an agonist of melanocortin-4-receptor (MC4R), which reduces food intake when activated.
Gut-derived signals include ghrelin, secreted primarily by the stomach that acts both directly and indirectly (via the vagus nerve) on the hypothalamus to increase appetite. Peptide YY is secreted by the distal

intestine and acts on the hypothalamus to decrease appetite. Both glucagon-like peptide-1 (GLP-1) and oxyntomodulin are produced in the intestine and brain; GLP-1 stimulates pancreatic insulin secretion, and both GLP-1 and oxyntomodulin inhibit food intake. Cholecystokinin is released from the intestine after feeding and acts centrally to inhibit appetite. Amylin is an anorexigenic peripheral neuropeptide secreted by the pancreas and has an analogue, pramlintide acetate, which is currently available for treatment of diabetes mellitus (6).

Endocannabinoid is an orexigenic system that includes receptors in the pleasure centre of the central nervous system, as well as in many organs associated with feeding and energy regulation. Experiments with cannabinoid antagonists have demonstrated reductions in food intake and body weight (6).

The contributions of genetics to the etiology of obesity have been evaluated in many studies (7). Monogenetic obesity accounts for approximately five percent of all cases of extreme human obesity. Example of "pure" genetic obesity includes errors in the α-melanocortin-stimulating hormone receptor (MC4R) and leptin receptors. The effect of these errors results in severe hyperphagia. The more common polygenetic obesity is an area of interest and study that may result in the identification of genetic obesity that influences weight status in a greater percentage of obese individuals. Complicating the understanding of polygenetic causes of obesity is the influence of the environment on genetic makeup, as well as gene-gene interactions that influence outcome.

The current hope is that researchers will identify modifiable determinants of obesity that can be targeted for intervention to successfully treat obesity.

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ADIPOCYTOKINES AND GHRELIN LEVELS OF TEENAGE ARAB GIRLS AS INFLUENCED BY DIET AND SLEEPING PATTERNS

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A recent study conducted among school children revealed that short sleep duration and quality is significantly associated with the increased prevalence of childhood obesity in the kingdom (1). On the other hand, adipose tissue is now generally considered not only as a passive energy store but also as an active endocrine organ with a high metabolic activity. It plays a crucial role in the regulation of energy homeostasis, insulin sensitivity and lipid/carbohydrate metabolism (2). Understanding this interplay between hormones of obesity in diet and sleeping pattern may help design effective intervention strategies and understand why abnormal sleeping behavior contributes to increased fat deposition**.** Having mentioned such points, this study aimed to determine the association between serum levels of these hormones with sleeping pattern and diet in obese and normal weight teenage Saudi girls. In this cross-sectional study, 126 school girls who provided consent participated (62 normal weight and 64 obese) aged 14–18 years (16.5 ± 1.5), and who were randomly recruited from the different girl's schools in Riyadh. A generalized questionnaire, which included diet and sleeping pattern, were submitted. Anthropometric data included body mass index, waist and hips measurements. Fasting blood samples were extracted on an assigned date and sera were separated. Fasting serum glucose and lipid profiles were measured using routine laboratory methods. Serum levels of insulin, leptin, adiponectin, resistin and ghrelin were quantified using enzyme-linked immunosorbent assays. Subjects with sleeping hours of <5 hours/day showed a higher percentage of carbohydrate intake ($p = 0.04$) and lower percentage of fat intake ($p = 0.03$) compared with those who slept >7 hours/day. Ghrelin had a significant inverse association with hours of sleep ($r = -0.18$; $p = 0.04$). Serum resistin on the other hand showed an increasing pattern that was directly proportional to hours of sleep, as well as serum adiponectin levels which were more pronounced in the normal group (see Figure 1). However, these

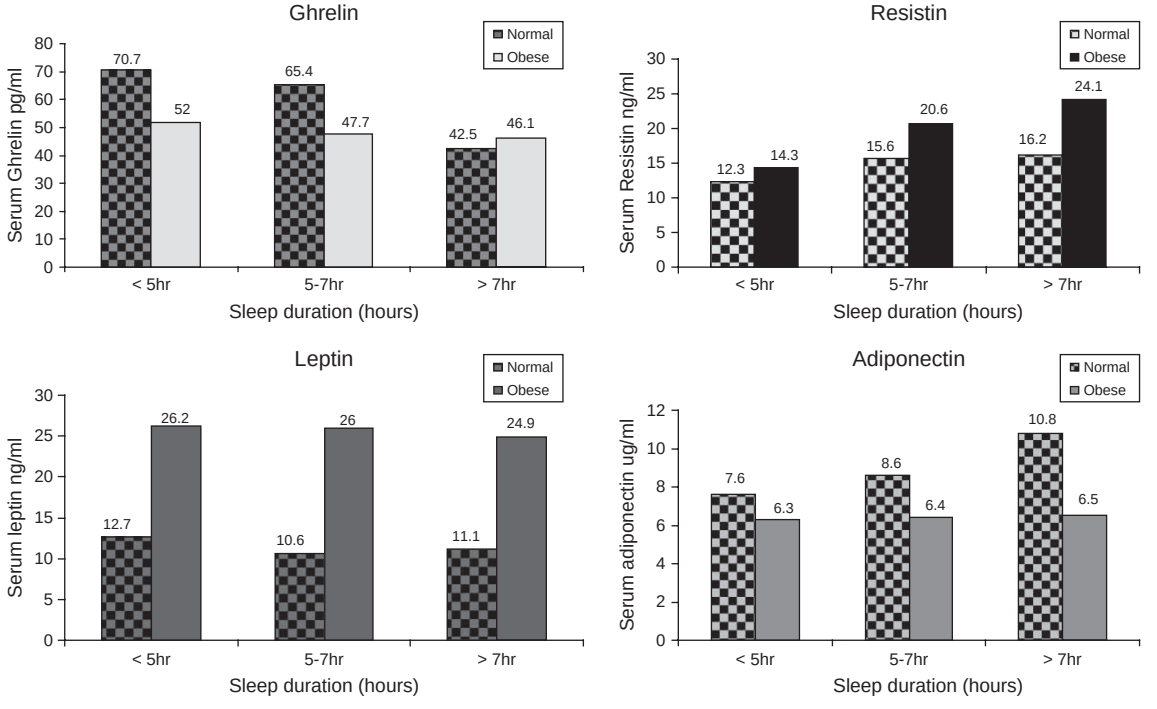

Figure 1. Hormonal patterns of subjects according to sleep duration.

patterns did not achieve significance. Leptin levels were not associated with sleep quality and duration. In conclusion, adiponectin, resistin and ghrelin are influenced by the pattern and the duration of sleep among Arab adolescent girls. The resulting obesity can be attributed to alteration of these hormones with a concomitant increased intake of carbohydrate-rich foods, as observed from those who sleep less and intermittently. Further studies in a bigger population using a prospective approach in a more controlled experimental environment are needed to confirm these findings.

Key words: Obesity, pediatrics, children, adolescent, adipocytokines, ghrelin, sleep

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PREVALENCE AND TRENDS IN OBESITY AND PHYSICAL INACTIVITY AMONG SAUDI CHILDREN AND ADOLESCENTS: A GROWING PUBLIC HEALTH CHALLENGE

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During the last three decades, Saudi Arabia has witnessed enormous lifestyle changes. Consequently, physical inactivity and sedentary living with associated rise in obesity are increasingly becoming prevalent in the society (1,2). The rising trends in obesity prevalence reflect a population shift towards positive energy balance (3). This abstract highlights some of our major research findings on physical activity/inactivity and obesity relative to cardiovascular health and fitness of Saudi children and youth.

The results of objective monitoring of daily physical activity levels, using heart rate telemetry, accelerometry and pedometry, indicated that over 70% of Saudi preschool children, about 60% of elementary school children and 71% of youth were not active enough to meet the minimal weekly requirement of moderate-to-vigorous health-enhancing physical activity (4,5,6). The proportions of Saudi children and youth who are at risk of physical inactivity are exceedingly higher than those who are at risk for hypertension, hypercholesterolemia, hypertriglyceridemia, or any other coronary artery disease (CHD) risk factors (7). Obese 8–12-year-old Saudi boys were significantly less active than non-obese boys. Active boys, on the other hand, exhibited significantly lower body fat percentage and BMI than inactive peers (8). In addition, active Saudi boys tend to have favorable levels of serum triglycerides and high-density lipoprotein-cholesterol compared with inactive boys (6).

In addition, body composition assessments conducted on Saudi school children indicated a high prevalence of obesity among them. Cross-sectional as well as longitudinal observations indicated that the obesity level is on the rise among Saudi children and youth (2,9,10). Recent findings of primary school boys living in Riyadh showed that the mean body fat percentage increased with age from 14.2% in the first graders to 24.6% in the sixth graders (9). In fact, not just body fat parentage increased with age among pre-school and primary school children but also fat mass (kg) and fat mass index (kg/m^2) (4,8). Comparison made between two sets of cross-sectional data conducted in the years 1988 and 2005 on Saudi school boys from Riyadh provided compelling evidence on the rising trends in body mass index, body fat percentage, central adiposity, and the prevalence of obesity among school boys, aged 6–14 years (9). Only 29% of primary school boys in urban areas walk to and from school. Boys who walked to school were found to have significantly less percentage of body fat than those boys transported to school by cars.

Furthermore, our decade-long longitudinal assessment of Saudi youth (10) indicated that the percentage of young Saudi males who were at risk for CAD increased substantially from childhood to early adulthood. Most notably, huge increases in obesity (5-fold), physical inactivity (30%), low cardiorespiratory fitness (>3-fold), low HDL-C (3.5-fold), and television viewing (>3-fold) were seen. Obese youth exhibited significantly higher levels of total cholesterol and triglycerides, as well as lower levels of HDL-C and the HDL-C/TC ratio (10). Our findings also indicated that tracking coefficients from childhood to adulthood for blood lipids, blood pressure and body fatness appeared fairly strong (r = 0.42–0.58). Physical activity, on the other hand, showed a fairly low tracking coefficient.

Our early research findings also showed that fit children were more active than less fit children (5,6). Body fatness correlated positively with several coronary heart disease risk factors, and negatively with cardiorespiratory fitness and physical activity (6). Obese youth tend to have less favorable levels of blood pressure, blood lipids and cardiorespiratory fitness compared with non-obese peers (10). They also spend more time viewing television (TV) and expend less energy in physical activity. Factors that predict physical inactivity to the greatest extent were obesity, low cardiorespiratory fitness, poor physical education program, time spent watching TV, and parental physical activity levels (5).

In conclusion, based on the available evidence, obesity and physical inactivity among Saudi children and youth represent a growing public health challenge, and actions to control obesity and promote physical activity must begin now. It is very critical that preventive strategies are implemented through schools and community-based programs, with involvement from health care providers, school teachers, community leaders, and policy makers, as well as parents.

Key words: Obesity, pediatrics, children, adolescent, Saudi Arabia, physical inactivity, trends, longitudinal, study

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CHILDHOOD OBESITY: CAN IT BE PREVENTED?

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The increasing prevalence of overweight and obesity in both the child as well as the adult population in Saudi Arabia highlights the need for prevention interventions across the life-course.

The United Kingdom Foresight Report on Obesity has emphasised that obesity is a "complex system", with many factors operating at both the individual and general societal level to promote excess dietary energy intake and decreased energy expenditure (1). The simulation modelling for health outcomes out to 2050 show that a general whole-of-population approach to preventing obesity is likely to lead to far better outcomes than an approach that solely focuses upon tackling childhood obesity. The International Obesity Taskforce's "obesity causal web" shows that most of the influences on an individual's or population's weight lie well beyond the capacity of the individual, the family or even the Health Sector to modify (2). Hence there is a need for a trans-sectoral and whole-of-government approach to obesity prevention. The implications of these models of causation are that change or intervention is needed across the whole of the "system map" and that many interventions at multiple levels are needed.

Reviews of childhood obesity prevention interventions show that programs can lead to short-term improvements in physical activity and nutrition behaviours; schools are a critical setting for programming; and engagement in physical activity is a critical intervention (3). Gaps in the evidence have been noted for immigrants, children aged 0–6 years, males, non-Western settings, home and community settings, and upstream, population-based interventions. In New Zealand, local community interventions, with a focus on school settings, led to a significant decrease in obesity prevalence in intervention schools/communities, compared with controls (4). Excitingly, the recent plateauing of obesity prevalence in France following a multi-level series of obesity prevention interventions, provides a glimmer of hope that obesity can be tackled, even in more obesogenic societies (5). The following issues should be considered when planning for obesity prevention at a national level:

- What is the relative level of investment in preventing adult versus childhood obesity?
- How "upstream" should-and can-the interventions be?
- Importance of a portfolio of interventions operating at many different levels
- Importance of developing the evidence base – embed evaluation!

Key words: Obesity, pediatrics, children, adolescent, prevention

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MANAGING CHILDHOOD OBESITY: EVIDENCE, CLINICAL GUIDELINES AND IMPLEMENTATION

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The 2009 revision of the Cochrane review on the treatment of childhood obesity (1) included 64 randomised controlled trials, 10 of which involved pharmacotherapy. Meta-analyses showed that family-based, lifestyle interventions with a behavioural program aimed at changing diet and physical activity provide significant and clinically meaningful decreases in overweight in both children and adolescents, compared with standard care or self-help, in the short- and the long-term. In addition, in obese adolescents, consideration should be given to the use of either orlistat or sibutramine, in the context of a lifestyle change program; however, such therapy needs to be carefully weighed up against the potential for adverse events.
The review highlighted a number of gaps in the research evidence:

- What interventions work best for:
  1. Different levels of obesity severity, ages, and developmental stages?
  2. Long-term maintenance of healthy weight following initial treatment of obesity?
  3. Specific ethnicities, religious groups or culturally diverse populations?
- What family characteristics promote weight outcome success?
- What is the role of self-esteem and the family's capacity to change behaviour in effective treatment?
- What are the most cost- and resource-effective methods of treating paediatric obesity in different health care settings?
- What is the role of bariatric surgery in the treatment of severely obese adolescents?
- What are the potential harms as well as benefits of different interventions?

The history of obesity clinical guideline implementation is not encouraging, with many countries' guidelines being inadequately disseminated, and the uptake and impact never evaluated. The following is recommended when developing clinical guidelines for use in everyday clinical practice (2):

- Focus on outcomes
- Should be based on the best available evidence and include a statement on the strength of recommendations
- The process of going from evidence to clinically useful recommendations requires good sense and judgement
- Process should be multidisciplinary and involve consumers
- Should be flexible, taking into account clinical settings, costs and constraints, as well as patient preferences
- Should be developed with the dissemination plan in mind
- The implementation and impact of guidelines should be evaluated
- Guidelines should be revised regularly

Key words: Obesity, pediatrics, children, adolescent, evidence, clinical guidelines, implementation

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THE SCHOOL AND THE OBESE CHILD: TEACHING AND APPLYING THE ABCS OF HEALTHY LIFESTYLE AT AN EARLY AGE

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Childhood obesity is the single most important health threat facing today's youth. Currently, there is a notion that involving schools can play a prominent role in the battle against this epidemic (1). Several aspects within the school premises have been identified as keys to effective promotion of the child's overall health and well-being: the school food environment; the physical activity environment; body mass index measurements and school polices (2). Strategic changes to school food environments and practices while maintaining adequacy of nutrient intake are essential in improving the child's diet and eating pattern (3). School breakfast participation for one, is associated with lower body mass index and as such, should be encouraged as it offers a protective factor against obesity (4). Physical activity on the other hand should be emphasized as it enhances cognitive performance; has a positive influence on children's psychological and social well-being; and most importantly, it decreases risk factors for future chronic diseases (5). Moving on to body mass index measurements at school, it provides awareness as to the child's degree of obesity and as such, prepares the child for the appropriate school programs that are designed to modify existing behaviors and lifestyles. Lastly, effective school polices, such as the use of a systematic legal framework to address the multiple factors that contribute to obesogenic environments, can assist in the development, implementation, and evaluation of a variety of legal approaches for obesity prevention and control (6). It is more essential to start with small changes that are feasible than to wait until resources become available to address all of the policy options at once. For example; removal of non-nutritious high-calorie beverages from schools, providing the school cafeteria with all healthy attractive choices, limiting the fast food restaurants closer to schools and colleges, eliminating all junk food ads on street banners and/or television, setting up quality control for the food brought to schools by students, replacing all school stores and vending machines with healthy foods, and increasing the number of physical education classes and/or sports classes for all age groups. In conclusion, schools represent the next logical site for prevention of childhood obesity second to home. The four key areas identified once modified and customized to prioritize a child's health, can translate to a very powerful tool that will not only prevent the child from a multitude of chronic diseases ahead, but also establishes the child's productivity and longevity in the future.

Key words: Obesity, pediatrics, children, adolescent, healthy lifestyle, school

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ESTABLISHING A TERTIARY LEVEL CHILD AND ADOLESCENT WEIGHT MANAGEMENT SERVICE: LESSONS LEARNED

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Despite the increasing public recognition of the problem of obesity in many countries, the planning for effective treatment services, especially for children, has lagged behind. Following are some personal reflections on the elements found useful on developing a bariatric medicine service within a large pediatric hospital.

Effective staffing is vital. Staff members should be flexible and willing to move outside traditional professional "silos" of knowledge; they should have good teamwork skills, cultural competence and a respectful attitude towards obese people. A multidisciplinary clinical team is required, and ideally should include senior nurse (often the "conductor of the orchestra"), pediatric physician, dietitian, clinical psychologist, social worker, and exercise professional (ideally a dual-trained exercise scientist/physiotherapist).

The clinic facility should have disabled access and wide corridors and doorways, with chairs that are sturdy and can seat large people, weight scales that allow sensitive measurement of very large people (e.g., 250^{+} kg) and large blood pressure cuffs. The service should be supported by a database that can also allow audit and research studies to be undertaken.

In establishing such a service, it is important to make the issue of obesity the problem of the institution, and not just of a few enthusiastic clinicians, and hence senior management and clinicians need to be engaged with the issue early. Ongoing health professional training of many levels of staff is required, from undergraduate level through to continuing postgraduate professional education, and for many types of clinician. Coordination with services that manage co-morbidities (e.g., Sleep Unit, Hepatology, Endocrinology, Dermatology, Psychiatry, General Medicine, Gynaecology, Orthopaedics, and Adolescent Medicine) is vital – shared protocols for assessment and management may need to be developed and key staff in the other services may require additional training regarding obesity. Families and young people with severe obesity may have significant family dysfunction, psychiatric co-morbidities and/or parenting concerns; hence the importance of effective links with Psychiatry, Social Work and even Child Protection Services, and the need for obesity clinical staff to have a good understanding of the psychosocial aspects of pediatric medicine.

Finally, a tertiary pediatric bariatric medicine service should only be one part of a much larger coordinated system of delivering health care within a region or country to obese children and adolescents. The Kaiser Permanente Chronic Disease Management model recognises that three different levels of chronic disease care should be offered: Level 1 care, suitable for the vast majority of those affected, emphasises patients' (or patients' families') central role in managing their health, supported by family doctors and community and other health system resources. Level 2 is care of high-risk patients by multidisciplinary disease management protocols and Level 3 is active case management of highly complex patients.

Key words: Obesity, pediatrics, children, adolescent, weight management

PEDIATRIC BARIATRIC SURGERY: WHERE DO WE STAND?

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Bariatric surgery is the most effective and longest-lasting treatment for morbid obesity and many related conditions in selected patients. Surgery for severe obesity displays benefits beyond weight loss. Mounting evidence suggests that bariatric surgery is among the most effective treatment for metabolic diseases and conditions including type 2 diabetes mellitus (T2DM), hypertension, hypercholesterolemia, non-alcoholic fatty liver disease, and obstructive sleep apnea (1). Surgery results in the complete remission or significant improvement of T2DM and other life-threatening diseases in most morbidly obese patients. A significant debate surrounds the risks and benefits of bariatric surgery in the adolescent population, yet contemporary studies demonstrate the success of this option for appropriate patients (2–4). Up to 1% of patients who have received bariatric surgery are under the age of 18 years. Significant number of pediatric bariatric surgeries are now performed on the young obese population. In the year 2004, over 2 000 pediatric patients at the age of 21 or younger underwent bariatric surgery in the United States (3,4).

When considering weight loss surgery in children and adolescents, the indications, the type of procedure, and the age at which it can be performed remain controversial. The indications for bariatric surgery in adults have been based upon a National Institute of Health consensus panel (5). Generally, adults with body mass index (BMI) of 40 with or without co-morbidities, or BMI of 35 with co-morbidities, are considered candidates for bariatric surgery. This panel specifically avoided making a recommendation for the treatment of patients younger than 18 years. A task force convened by the American Pediatric Surgical Association (APSA) addressed this issue. The indications for surgery in the APSA task force recommendations are much more conservative than those for adults (6). Evidence suggests that early surgical intervention in extreme obesity provides the best chance to reverse co-morbidities (7–9).

The author argues that available data support more aggressive treatment of adolescent obesity by using established adult criteria. The primary rationale is three-fold. First, children and adolescents tend to display relatively more obesity and co-morbidities than adults at the time of clinical presentation. Second, children and adolescents stand to suffer a greater loss of life span and productivity as a result of untreated obesity (than adults). Third, children and adolescents currently lack any effective medical alternatives for chronic weight maintenance or weight loss. Clearly, more medical research is needed for pediatric patients. Thus, our criteria to consider pediatric patients for surgery resemble those for adults, but also include a supportive family environment, failure to obtain weight loss for at least 6 months (with a conservative medical treatment), and willingness and motivation by the patient and patient's family to undergo surgery and to follow strict post-operative instructions. An algorithm is suggested (Figure 1) based on our clinical experience.

Setting age limits for surgery is complex. A legitimate concern about bariatric surgery is potentially adverse growth sequelae. This concern can become reality for those procedures that result in significant malabsorption (e.g., gastric bypass). However, procedures like gastric banding and sleeve gastrectomy are relatively safe in younger patients. We have performed gastric banding and gastric sleeve on patients as young as 8 years of age who continued their normal growth. Long-term follow-up is mandatory.

For children and adolescents, the ideal bariatric surgical intervention should be effective, safe, and applicable to all patients. Surgery must achieve considerable weight loss and resolution of co-morbidity. Low operative morbidity and mortality is essential, with a short hospital stay, rapid return to normal activity, and, most importantly, reversible. The author opines that laparoscopic gastric banding and sleeve gastrectomy are the best available options now for pediatric obesity. Furthermore, gastric bypass should not be the first choice in children and adolescents. Certainly, all candidates are informed about all therapeutic options, including the advantages and disadvantages of each. Sleeve gastrectomy (SG) is recommended for those unable to be very punctual with the banding adjustment protocol. SG arose after the time delay associated with bypass in the super obese. Gastric bypass is very difficult to reverse in pediatric patients and can only be partially reversed.

In summary, morbid obesity is associated with multiple metabolic, physiological, and psychological abnormalities. These co-morbidities markedly reduce the lifespan of the obese population. Bariatric surgery effectively reduces weight, but also resolves many co-morbidities thereby improving patients' quality of life. Different bariatric surgical techniques help achieve marked weight loss in morbidly obese patients.

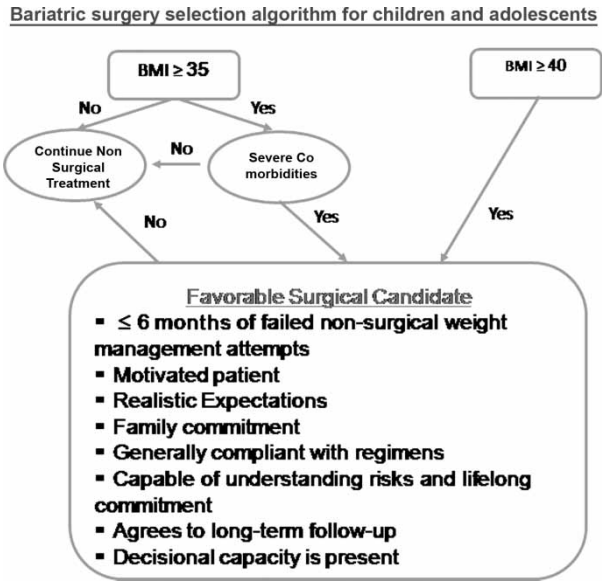

Figure 1. Bariatric surgery selection algorithm for children and adolescents.

At present there is considerable interest in Laparoscopic Adjustable gastric Banding in pediatric patients, given its efficacy and relative safety. Loss of the excess weight usually peaks at 2–3 years after surgery. Three studies showed persistent weight loss at over 50% after 5 years. LAGB is also easier to perform than gastric bypass.

Although gastric bypass operations carry potential to achieve greater weight loss, this benefit is tempered by their increased risks of mortality and morbidity. Further, the bypass procedure is technically demanding, and surgeons must pass through a learning curve before embarking on bypass.

Sleeve gastrectomy is a very suitable procedure in the adolescent population; however, long-term studies are not yet available. One factor should remain in the forefront when deciding on the type of bariatric surgery in children and adolescents: reversibility when possible. Guidelines and protocols for pediatric obesity should be established by multidisciplinary experts and endorsed by professional societies (see Figure 1)

Key words: Obesity, pediatrics, children, adolescent, bariatric surgery, Sleeve gastrectomy, banding

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