

Obesity: Increased risk of chronic non-communicable diseases in South Africa and India

Sunitha C Srinivas, Natisha Dukhi, Wendy Wrench

Faculty of Pharmacy, Rhodes University, Grahamstown, South Africa 6140

Address for Correspondence: s.srinivas@ru.ac.za

Abstract

Although the incidence of chronic non-communicable diseases (CNCDs) is increasing, CNCDs were not included in the United Nations Millennium Development Goals (2000) which focussed on the major global challenges of communicable diseases, child and maternal health and poverty-related issues along with strengthening health policies. Although some countries have since incorporated CNCDs into the MDGs, this has not happened globally, a matter which requires urgent attention. Obesity and physical inactivity are risk factors for some CNCDs such as cardiovascular disease and diabetes. The incidence of these risk factors is increasing in developing countries such as India and South Africa with an increase in urbanization and the influence of Westernization playing an important role. Cultural influences may also play a role in the increase in obesity e.g. in South Africa, being overweight or obese is associated with affluence and happiness in some cultures. The World Health Assembly Global Strategy on Diet, Physical Activity and Health (2004) provides guidelines to reduce global disease, deaths and CNCD risk factors, with an emphasis on improvement of diet and physical activity promotion. To reduce the incidence of CNCDs, these guidelines should be implemented using a multi-sectoral and multi-stakeholder approach.

Key words: Obesity, chronic non-communicable diseases, Millennium Development Goals.

Global health risks, the World Health Organisation's upcoming report on global and regional mortality and disease burden, identifies the following five leading risk factors that account for one-quarter of all deaths in the world and one-fifth of all disability-adjusted life years (DALYs): being underweight in childhood, unsafe sex, alcohol use, unsafe water and sanitation and high blood pressure¹. Global health is in a state of transition, with Chronic Non Communicable Diseases (CNCDs) such as cardiovascular diseases and diabetes, causing double the number of deaths ascribable to infectious diseases^{2,3}. Exposure to unhealthy dietary habits and a sedentary lifestyle, especially among indigent urban populations, increases the risk of CNCDs⁴. Unhealthy diet and physical inactivity risk factors are the result of a complex interplay of various factors that include irregular, unbalanced meals; aggressive fast food marketing; sedentary lifestyles; adverse economic, social and environmental conditions; urbanization; industrialization and global trade^{5,6,7}. During the 20th century in most regions around the world, an extensive range of demographic and socio-economic shifts has resulted in major changes in diet and physical activity.

There has been a steady increase in the consumption of partially hydrogenated fats, refined carbohydrates, and a substantial decrease in consumption of whole grains, fibre, fruits and vegetables^{8,9}. Also, increasingly, food is seen by many people as a beauty and health tool or emotional medication and not as providing nutritional satisfaction¹⁰. Physical activity has been greatly reduced by urbanization, industrialization and mechanized forms of transport⁹. Approximately 1.9 million deaths occur among populations annually due to physical inactivity¹¹. People with lifelong habits of reduced physical activity and unhealthy diets have an increased risk of obesity and this in turn leads to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance¹² which ultimately can cause cardiovascular diseases (CVD), type 2 diabetes, dyslipidemia, osteoarthritis and some forms of cancer^{13,14}. The CVD burden is increasing rapidly in middle and low income countries and affects young economically productive people. If the overwhelming CNCD risk factors are addressed adequately, quality of life may be increased¹⁵. In the last five decades, unhealthy weight prevalence has been increasing steadily, and obesity is reaching epidemic levels in both developing and developed countries^{16,17}. Obesity has presented as the most prevalent global nutritional problem over the last two decades,

eclipsing infectious diseases and under-nutrition as a significant mortality and ill-health contributor. Globally an estimated 1 billion adults are overweight, with 300 million of them being obese¹⁷. An estimated 155 million obese children contribute to this epidemic¹⁸. Obese children tend to become obese adults. Obesity-related health problems occur in the early years of life and progress into adulthood¹⁴.

Obesity results in some non-fatal but incapacitating health problems such as respiratory difficulties, chronic musculoskeletal problems, skin problems and infertility but most significantly results in four main areas of life-threatening health problems: CVDs; conditions associated with insulin resistance such as type 2 diabetes; certain types of cancers, especially the hormonally related and large-bowel cancers; and gallbladder disease. The World Health Report of 2002 highlighted that globally, approximately 58% of diabetic cases, 21% of ischaemic heart disease cases and 8-42% of certain cancers were attributable to a body mass index (BMI) above 21 kg/m²(12).

In 2005, 60% of all deaths in the world were attributed to CNCDS, which caused an estimated 35 million of the 58 million global deaths. It has to be noted that CNCDS account for double the number of deaths from all infectious diseases (including HIV/AIDS, tuberculosis and malaria), maternal and perinatal conditions, and nutritional deficiencies combined^{3,19}. It is equally important to note that of the 60% global mortality, 80% of CNCDS related mortality rates occur in 23 middle and low income countries, which include South Africa and India²⁰. These appalling statistics when viewed against the popular misconception that CNCDS affect only populations in high income countries, shows the major challenges that countries like South Africa and India face due to the double burden of infectious diseases along with CNCDS.

In order to address the global health challenges, the Alma Ata declaration of 'Health for all' was followed up by Millennium Development Goals (MDGs)^{21,22}. The UN Millennium declaration was signed by 189 countries in 2000 and was developed into the MDGs²³. The eight MDGs emerged to assist in focusing attention on major global challenges of communicable diseases, child and maternal health and poverty-related issues along with strengthening health policies²⁴. While the public health and medical communities can rejoice that three of the eight MDG goals are specifically health focused, it is extremely important to note that CNCDS have not been

included within the global MDG targets^{15,24}. Prioritization and investing in CNCDS prevention as well as management is misconceived to remove the emphasis from communicable disease^{11,15}. Countries with poor health status are far from the health targets, are unlikely to make any progress substantially, and are unlikely to achieve the MDGs by 2015²³, especially in sub-Saharan Africa²⁵. As a way forward to deal with CNCDS which are the major cause of adult illness and death, some countries are adapting their MDG goals to incorporate CNCDS. Countries such as the Czech Republic, Mauritius, Poland and Thailand have included new indicators such as heart disease prevalence and death rates to monitor their MDGs while countries such as Hungary, Indonesia, Jordan and Lithuania have started noting the importance of chronic diseases in their countries' MDGs. This is an important step forward in addressing this immense challenge³.

South Africa:

Since 1996, after overcoming the Apartheid era, South Africa has been investing resources in collecting valuable data that informs the current situation, highlights various health care challenges and paves the path for addressing the enormous challenges in the area of CNCDS along with other health related problems. A few of the important strategies and studies are highlighted below:

- The introduction of the Outcome Based Education (OBE) systems implemented at schools resulted in life skills being integrated into the curriculum. In 1997 both HIV/AIDS and life skills education commenced as part of the Department of Health's initiative²⁶. Stakeholders noted that communication as part of information exchange in health education was important and not only based on HIV/AIDS but included various other health issues of importance²⁷. Health promotion activities in schools have been recognized as an effective way of addressing health related awareness in the community²⁸.
- The 1999 National Food Consumption Survey (NFCS), documented the prevalence of being overweight at 17% and this increased concerns regarding the nutrition transition, CNCDS and its association to urbanization²⁹. CNCDS are the leading causal agents of death in every region of the world except lowest-income countries and sub-Saharan Africa. While HIV/AIDS is the leading cause of death in South Africa, CVD is ranked first in women's burden of disease¹⁵.

- According to data from the South African Demographic and Health Survey (SADHS) in 1998, as education levels increase so do unhealthy dietary habits and physical inactivity due to urbanization and other related factors³⁰. This suggests that access to education does not necessarily translate to a greater awareness about healthy lifestyle.
- Obesity emergence especially in Black African women has been documented in studies over recent years³¹. The 1998 SADHS revealed that 56% of women and 29% of men were either overweight or obese. Comparing urban and rural situations, 33% of urban women and 25% of non-urban women were identified as either overweight or obese³².
- In 2000, a study of BMI contributing to an estimated disease burden was conducted among the four population groups of South Africa. This study highlighted the similarity among Coloured, Indian and White populations who subsisted on a diet high in fat and sugar, and low in fibre and carbohydrate. This study also reveals that while urban Black Africans tend to consume a western diet, rural Black Africans tend to follow a traditional diet high in carbohydrates and fibre but low in simple sugars and fat³². Traditional perceptions and culture regarding body size promote the use of food rich in fat and sugar. In Black communities, being overweight has positive connotations and is considered a sign of happiness and affluence³³. Black women are feeling the pressure mounting on them as they are subjected to the norms of Westernization, whereas local tradition emphasizes the desirability of a larger body size. Also, a thin figure is associated with sickness and being HIV positive³⁴.
- In 2001, a South African report discussing 'Poverty and chronic diseases' highlights that as people get richer, obesity and hypertension emerge as risk factors. Therefore it is important to protect poor people from these risk factors because economic progress and upward social mobility increases the risk of major changes in diet and physical activity³⁵.
- In the 2002 National Youth Risk Behaviour Survey with adolescents, overweight prevalence was documented at 17% and postulated to be due to increased energy-dense food consumption and low physical activity levels. Nationally 37.5% of adolescents have shown no or very little physical activity and this confirms the decrease in physical activity²⁹.
- The 2003 SADHS was carried out as a follow up survey to the 1998 SADHS. These surveys assist in

tracking changes in the population's health status, identifying risk factors as well as in understanding if health services are accessible and utilised by the population. The 2003 SADHS survey highlights that being overweight or obese has not changed since 1998 and remain particularly high for women. Fifty five% of women and 30% of men aged 15 and above are overweight or obese and the survey also points out that currently there is considerable evidence of health problems associated with excess bodyweight which highlights the urgent need to initiate healthier environments and lifestyles among all ages.

It is interesting to note that for the first time in the SADHS, physical activity was measured compared to other countries. It is not surprising that the survey shows very high levels of inactivity, especially in urban settings, with 48% of men and 63 % women in South Africa being inactive. This data is extremely important to set the trend in understanding the reasons behind this behaviour and then setting agenda to change it so as to avoid the resulting burden of diseases³⁶.

In 2004, a Multi-sectoral National Health Lifestyle Task Force was established and a strategy document was drafted in 2005 which is currently in the advocacy stage. In 2004, government and private sectors, NGOs and tertiary institutions convened for the Youth Charter on Physical Activity Sport Stakeholder Workshop, which resulted in drafting the Youth Charter and constituting a steering committee³⁷. As part of the Healthy Lifestyle initiative of the Department of Health, "Vuka South Africa" was formed in 2005 with the intention of expanding health education, identifying benefits of fitness and promotion of physical activity. The Move for Health core message is the encouragement of individuals to participate in 30 minutes of moderate physical activity as many times in a week as possible³⁸.

In South Africa, although policies and guidelines for the management and prevention of CNCDs have been developed, their successful implementation at the provincial and local levels has yet to be achieved³⁹. Inadequate staff and training, short consultation times, infrequent use of clinical treatment guidelines, little patient education in regard to self-care and low rates of regular clinic attendance and adherence to medication are some of the factors that constrain the management of these chronic conditions⁴⁰. In addition, attitudes of health care professionals and patients may hinder optimal prevention and management of CNCDs such as hypertension and diabetes^{41,42}.

India:

WHO Global info base, a data warehouse that collects, stores and displays information on chronic diseases and their risk factors for all WHO member states reports that 15.2% of females and 16.8% of males fall into the overweight/obesity range $\geq 25 \text{ kg/m}^2$ ⁽⁴³⁾. In India, 10-24.9% of women aged 30 and above fall into the overweight range (BMI equal to or greater than 25 kg/m^2) whereas as in South Africa in 2005, more than 75% of women fell into this category. It has been projected that by 2015, the number of overweight women in India will increase to 25-49.9% which will have dire consequences w.r.t. the prevalence of CNCDS³. It is important to note that overweight is more prevalent among female, urban and high-socioeconomic-status (SES) groups⁴⁴ and the prevalence of diabetes, hypertension and coronary artery disease is two- to threefold greater in the urban population than in rural populations⁴⁵.

A WHO report highlights that in 2005, projected death rates from CVDs in India was 400 per 100,000 when compared to less than 100 per 100,000 from HIV/AIDS, TB and Malaria. This data highlights the myth that 'Low and middle income countries should control infectious diseases before chronic diseases'. CNCDS are preventable and therefore it is important to adopt health promotion strategies rather than wait until the challenges of infectious diseases have been addressed. India has to guard against another misunderstanding that 'Chronic diseases affect old people'. The statistics show that projected chronic disease death rates in 2005 for people aged 30-69 years were close to 700 per 100,000 in India whereas it was only 500 per 100,000 in China. A common misunderstanding that 'Chronic diseases affect men more than women' has to be reconsidered because global statistics show that projected global coronary heart disease deaths in 2005 affected not only 53% men but also 47% women. In the light of all these statistics it is important to consider that chronic disease prevention strategies are cost-effective and have to be implemented without delay³.

The WHO is estimating an increase of 42% in the number of diabetics in the developed countries but an enormous increase of 170% in developing countries by 2025. Among the various regions that will be most affected by this increase is the South East Asia region which is expected to carry the maximum global burden of diabetes⁴⁶.

India requires urgent policy and regulatory governmental interventions along with societal and

individual management of obesity and cardio vascular diseases to sustain the economic boom with health population to avert the growing epidemic due to increased risk factors which range from urbanization to possible genetic predisposition due to lipoprotein (a) excess⁴⁷. If urgent attention is not paid to these epidemic health challenges, increasing trends of CNCDS such as CVDs and diabetes will result in calamitous consequences for developing countries like China, India and the Russian Federation which are expected to lose between \$200 billion and \$550 billion in national income over the next 10 years³.

Way forward:

The World Health Assembly Global Strategy on Diet, Physical Activity and Health (2004) provides guidelines to reduce global disease, deaths and CNCDS risk factors, with improvement of diet and physical activity promotion, resulting in effective preventative interventions. The way forward is drafting and implementing action plans and policies from global to community levels⁴⁸. As part of the CNCDS action plan, various responses are necessary at national level which include: research capacity promotion; health-related socio-economic, environmental and behavioural policies; policies in public and private sectors; capacity building; addressing health inequalities and burden of disease monitoring⁴⁹. This global strategy uses experience, evidence and the best practices of countries that are addressing CNCDS prevention, along with health, physical activity and nutrition knowledge from developed and developing nations. Thus countries can choose from a policy 'toolbox', with the strategy emphasizing that a multi-sectoral and multi-stakeholder approach to CNCDS reduction is needed to decrease the global disease burden⁴. Therefore the Global Strategy on Diet, Physical Activity and Health must be implemented at a national level¹¹.

Scope exists for the dietary and environmental factors of obesity prevalence to be better understood by researchers. Many countries lack the necessary data, particularly for children, as it is in this population group that unhealthy diet and physical inactivity have increased noticeably. Obesity co-morbidities and the BMIs of the various ethnic groups need identification, along with documentation of obesity high risk factors in populations⁵⁰. A grounded protocol that addresses the major knowledge gaps needing to be filled with emphasis on risk factors in all populations is an

For nutritious food selection, knowledge and support is necessary for communities. Necessary healthy diet messages must be creatively conveyed to target groups. Where the resources of government are poor, effective working partnerships between NGOs, schools, families, health professionals, policy makers, corporate leaders, key leaders, government stakeholders, faith-based organizations and local communities are vital to initiate, develop and implement intervention^{51,52,17}. There is a need for operational research to develop effective community-based prevention programmes as part of interventions⁵³. Specifically, the Health and Education Departments, as government stakeholders, play an important role in facilitating the understanding of the contributing risk factors for diet and decreased physical activity in children and adults¹⁷. Interventions focusing on the risk factors make CNCDS preventable and accomplish improvement, which can reduce morbidity, mortality and disability, leading to more positive health outcomes⁵⁴.

It is estimated that by the year 2020, lifestyle-related CNCDS will account for 60% of the burden of disease, and 70% of deaths worldwide, if adequate health promotion intervention programs are not established. It is possible to reduce mortality rates by 2% annually during the 2006 - 2015 period if the global goal of CNCDS prevention is achieved. This achievement would avert 24 million deaths in the 23 middle and low-income countries⁵⁵.

To reduce the chronic disease burden, modification of lifestyle, promotion of preventative measures in health care systems, improved dietary habits and physical activity, community-based interventions for all age groups, and initiatives to create awareness of risk factors in the most vulnerable sectors of the population are vital^{56,20}. It is important for health systems to be developed to address all CNCDS together rather than in a "disease by disease" vertical pattern¹⁵.

Although evidence indicates that there is feasibility in unhealthy lifestyle prevention in both children and adolescents, lack of information on intervention development, implementation and content, leads to inadequate intervention programme components being determined⁵⁷. Also, generally nutrition programs tend to focus on children under five years of age, infants, lactating and pregnant mothers. School-going children are generally not included in these programs. This neglected group presents an opportunity for constructive intervention⁵¹. Nutrition education provided during

childhood enables this group to begin making informed dietary behavior decisions. Thus, during these school-going years, prevention of obesity is vital as juvenile obesity often worsens or begins during this period of accelerated growth⁵⁸.

REFERENCES:

1. Stevens G, Mascarenhas M, Mathers C. Global health risks: progress and challenges. *Bulletin of World Health Organisation* 2009;87:646.
2. Waxman A. WHO's global strategy on diet, physical activity and health, *Scandinavian Journal of Nutrition* 2004;48(2):58-60.
3. WHO. Preventing chronic diseases: a vital investment. 2005. Available at: http://www.who.int/chp/chronic_disease_report/full_report.pdf. Accessed June 1, 2009.
4. Parker W. Chronic Non-Communicable Diseases. Available at: 2008. Accessed June 1, 2009.
5. Popkin BM. Symposium: Obesity in Developing Countries: Biological and Ecological Factors, The Nutrition Transition and Obesity in the Developing World. *Journal of Nutrition* 2001;131: 8715- 8735.
6. Swinburn BA, Caterson I, Seidell JC, James WP. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutrition* 2004; 7(1A):123-146.
7. Waxman A, Norum KR. Why a global strategy on diet, physical activity and health? The growing burden of non-communicable diseases. *Public Health Nutrition* 2004;7(3):381-383.
8. Friel S, Chopra M, Satcher D. Unequal weight: equity oriented policy responses to the global obesity epidemic. *British Medical Journal* 2007;335:1241-1243.
9. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with non communicable diseases. *American Journal Clinical Nutrition* 2006;84:289-298.
10. Hawks SR, Madanat HN, Merrill RM, Goudy MB, Miyagawa T. A cross-cultural analysis of "motivation for eating" as a potential factor in the emergence of global obesity: Japan and the United States. *Health Promotion International* 2003;18:2.
11. WHO. Cardiovascular diseases in the African region: Current situation and perspectives. Available at: www.afro.who.int/rc55/documents/afrc55_12_cardiovascular.pdf Accessed 2 June 2009.
12. WHO. Obesity and Overweight. Available at http://www.who.int/dietphysicalactivity/media/en/gfs_obesity.pdf Accessed 2 June 2009.

13. Sluijs VEMF, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *BMJ* 2007;335:703.
14. Lau DCW, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children (summary), *Canadian Medical Association Journal* 2007;176 (8 suppl):S1-13.
15. Fuster V, Voûte J. MDGs: chronic diseases are not on the agenda, *Lancet* 2005;366 (9496):1512-1514.
16. Müller MJ, Asbeck I, Mast M, Larnäse K, Grund A. Prevention of Obesity- more than an intention. Concept and first results of the Kiel Obesity Prevention Study (KOPS). *International Journal of Obesity* 2001;25:(1):S66-S74.
17. Kruger HS, Puoane T, Senekal M, Merwe VDMT. Obesity in South Africa: challenges for government and health professionals. *Public Health Nutrition* 2005;8(5):491-500.
18. Hossain P, Kawar B, El Nahas M. Obesity and Diabetes in the Developing World —A Growing Challenge. *The New England Journal of Medicine* 2007;356(3):213-215.
19. WHO. 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Non-communicable Diseases. Available: www.who.int/entity/nmh/NCD-action-plan-2008.pdf [12 May 2009].
20. Abegunde DO, Mathers CD, Adam T, Ortegón M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet* 2007;370:1929-1938.
21. Declaration of Alma-Ata. Available at: http://www.who.int/hpr/NPH/docs/declaration_almaata.pdf. Accessed on 9 September 2009.
22. Millennium Development Goals. Available at: <http://www.undp.org/mdg/basics.html>. Accessed on 9 September 2009.
23. Travis P, Bennett S, Haines A, Pang T, Bhutta Z, Hyder AA. et.al. Overcoming health-systems constraints to achieve the Millennium Development Goals. *Lancet* 2004;364:900-906.
24. Fuster V, Voute J, Hunn M, Smith SC. Low Priority of Cardiovascular and Chronic Diseases on the Global Health Agenda: A Cause for Concern. *Circulation* 2007;116:1966-1970.
25. Pettifor JM. Are we achieving the Millennium Development Goals?, *South African Journal of Clinical Nutrition* 2008;21(1).
26. Patel N. The life skills education programme. 2007. Available at: www.witsetd.wits.ac.za:8080/dspace/bitstream/123456789/2188/13/PatelN Accessed 2 June 2009.
27. Govender S, Edwards S. Appreciative inquiry into lifeskills-based HIV/AIDS education in South African schools. *African Journal of AIDS Research* 2009;8(1):115-121.
28. WHO. A Special Health Promotion Project : The Health Promoting Schools Initiative. Available at <http://www.afro.who.int/healthpromotion/project.html> Accessed 18 September 2009.
29. Steyn NP, Mbhenyane XG. Workforce development in South Africa with a focus on public health nutrition. *Public Health Nutrition* 2008;11(8): 792-800.
30. Department of Health, 1998. South Africa Demographic And Health Survey – 1998. Available at: www.doh.gov.za/facts/1998/index.html Accessed 2 June 2009.
31. Temple NJ, Steyn K, Hoffman M, Levitt NS, Lombard CJ. The Epidemic of Obesity in South Africa: A Study in a Disadvantaged Community. *Ethnicity and Disease* 2001;11:431-437.
32. Joubert J, Norman R, Bradshaw D, Goedecke JH, Steyn NP, Puoane T, the South African Comparative Risk Assessment Collaborating Group. Estimating the burden of disease attributable to excess body weight in South Africa in 2000. *South African Medical Journal* 2007;97(8):683-690.
33. Puoane T, Steyn K, Bradshaw D, Laubscher R, Fourie J, Lambert V. et.al. Obesity in South Africa: The South African Demographic and Health Survey. *Journal of Obesity Research* 2002;10: 1038-1048.
34. Steyn NP. 'Big is beautiful' — and unhealthy and confusing? *South African Journal of Clinical Nutrition* 2005;18:1.
35. Poverty and chronic diseases in South Africa: Technical report 2001. Bradshaw D, Steyn K - Medical Research Council, 2002. Available at: http://www.agirn.org/documents/Poverty_chronic_diseases_SA_2001.pdf Accessed 9 June 2009.
36. Department of Health, Medical Research Council, OrcMacro. 2007. South Africa Demographic and Health Survey 2003. Pretoria: Department of Health.

37. WHO. Towards Implementation of the WHO Global Strategy on Diet, Physical Activity and Health: South African Experience [online]. Available at www.who.int/entity/dietphysicalactivity/strategy/southafrica%20presentation_wha59.pdf Accessed 9 June 2009.
38. Department of Health, 2005. Vuka South Africa. [online]. Available at www.durban.gov.za/durban/government/media/press/vsa Accessed 9 June 2009.
39. Bradshaw D, Norman R, Pieterse D, Levitt NS. Estimating the burden of disease attributable to diabetes in South Africa in 2000. *South African Medical Journal* 2007;97(7):700-706.
40. Steyn K, Levitt NS. Health Services Research in South Africa - For Chronic Diseases of Lifestyle; Chapter 17, Chronic Diseases of Lifestyle in South Africa since 1995 - 2005; pp.226-248, Available at: <http://www.mrc.ac.za/chronic/cdlchapter17.pdf>. Accessed June 1, 2009.
41. Steyn K. Hypertension in South Africa, Chronic Diseases of Lifestyle in South Africa since 1995 - 2005, Chapter 8, pp.80-96. Available at: <http://www.mrc.ac.za/chronic/cdlchapter8.pdf>. Accessed June 1, 2009.
42. Rayner B, Blockman M, Baines D, Trinder YA. A survey of hypertensive practices at two community health centres in Cape Town. *South African Medical Journal* 2007;97(4):280-284.
43. WHO. India & Overweight & Obesity (BMI). Available at <https://apps.who.int/infobase/report.aspx?rid=114&iso=IND&ind=BMI>. Accessed on 18 September 2009.
44. Wang Y, Chen HJ, Shaikh S, Mathur P. Is obesity becoming a public health problem in India? Examine the shift from under- to overnutrition problems over time. *Obesity Reviews* 2009;10(4):456-474.
45. Singh RB, Rao PV, Das S, Madhu SV, Das AK, Sahay BK. et.al. Diet and lifestyle guidelines and desirable levels of risk factors for the prevention of diabetes and its vascular complications in Indians: a scientific statement of The International College of Nutrition. Indian Consensus Group for the Prevention of Diabetes. *Journal of Cardiovascular risk* 1997 Jun;4(3):201-208.
46. WHO. Non communicable diseases, Available at http://www.searo.who.int/en/Section1174/Section1459_7409.htm Accessed on 18 September 2009.
47. Enas EA, Singh V, Munjal YP, Bhandari S, Yadave RD, Manchanda SC. Reducing the burden of coronary artery disease in India: challenges and opportunities. *Indian Heart Journal* 2008;60(2):161-175.
48. WHO. Global Strategy on Diet, Physical Activity and Health. Available at www.who.int/dietphysicalactivity/strategy/strategy_english_web.pdf Accessed on 12 May 2009
49. Magnusson RS. Rethinking global health challenges: Towards a 'global compact' for reducing the burden of chronic disease. *Public Health* 2009; 123:265-274.
50. York DA, Rössner S, Caterson I, Chen CM, James WPT, Kumanyika S, Martorell R, Vorster HH. Prevention Conference VII: Obesity, a Worldwide Epidemic Related to Heart Disease and Stroke: Group I: Worldwide Demographics of Obesity. *Circulation* 2004;110: 463-470.
51. WHO. Strategic Directions. Available at: [www.searo.who.int/.../Nutrition_for_Health_and_Development_Annex-1\(Lifecycle_approach\).pdf](http://www.searo.who.int/.../Nutrition_for_Health_and_Development_Annex-1(Lifecycle_approach).pdf) Accessed on 2 June 2009.
52. Devlin LM. A Call to Action. *North Carolina Medical Journal* 2002;63(6):302-304.
53. WHO. Secondary Prevention of Non-communicable diseases in Low and Middle income countries through community-based & Health service interventions. Available at: www.who.int/cardiovascular_diseases/media/en/615.pdf Accessed on 2 June 2009.
54. WHO. Prevention and control of non-communicable diseases: implementation of the global strategy. Available at www.who.int/gb/ebwha/pdf_files/A61/A61_8-en.pdf Accessed on 2 June 2009.
55. Horton R. Chronic diseases: the case for urgent global action. *Lancet* 2007;370(9603):1881-1882.
56. Sarrafzadegan N, Kelishadi R, Esmailzadeh A, Mohammadifard N, Rabiei K, Roohafza H. et.al. Do lifestyle interventions work in developing countries? Findings from the Isfahan Healthy Heart Program in the Islamic Republic of Iran. *Bulletin of the World Health Organization* 2009;87:39-50.
57. Singh AS, Paw CAMJM, Kremers SPJ, Visscher TLS, Brug J, Mechelen VW. Design of the Dutch Obesity Intervention in Teenagers (NRG-DOiT): systematic development, implementation and evaluation of a school-based intervention aimed at the prevention of excessive weight gain in adolescents. *Public Health* 2006;6:304-310.
58. Holcomb JD, Lira J. Evaluation of Jump into Action: A program to reduce the risk of non-insulin dependent diabetes mellitus in school children on the Texas-Mexican border. *Journal of School Health* 1998; 68(7).