ICMR-CIHR Workshop

# "Childhood Obesity and Noncommunicable Diseases"

2009

ICMR

CIHR IRSC

**INDO-CANADIAN COLLABORATION**

ICMR-CIHR Workshop

**"Childhood Obesity and Noncommunicable Diseases"**

14-16, January 2009

# REPORT

**ICMR-CIHR Workshop**
**"Childhood Obesity and Noncommunicable Diseases"**

*Venue: Wet 'n' Wild Resort, 45-Milestone, Village Naurangpur, Jaipur Highway, Haryana, INDIA*

**Workshop Coordinators**

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Division of Noncommunicable Diseases
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Prashant Mathur

**Canadian Institutes of Health Research (CIHR)**
Institute of Human Development, Child and Youth Health (IHDCYH)
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Participants of the ICMR-CIHR Workshop on Childhood Obesity and Noncommunicable diseases, 14-16th January 2009, INDIA

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# Foreword

**Vishwa Mohan Katoch**
MD, FNASc, FAMS, FASc., FNA
**Secretary to the Government of India**
(Department of Health Research)
Ministry of Health & Family Welfare)
**DIRECTOR-GENERAL, ICMR**

India is facing the rising burden due to Noncommunicable diseases, and overweight and obesity in childhood is an important forerunner to adulthood chronic diseases. Early life interventions in adopting healthy lifestyles are a promising approach. The Council endeavors to work with partners towards translating the knowledge to policy and practice for prevention and control of Noncommunicable diseases.

Under the ICMR-CIHR Memorandum of Understanding (MoU), ICMR aims to facilitate research initiatives which would benefit local populations and have global applications as well. This collaboration would build competency as well as networks to address important health conditions like Obesity as equal partners in pooling expertise and resources.

I am pleased to see the report of the ICMR-CIHR collaborative workshop on "**Childhood Obesity and Noncommunicable Diseases**" held in India from 14th to 16th January, 2009. This marks the beginning of joint research adventures between the scientists of both countries on a range of issues deliberated and recommended in the workshop.

I wish the coordinators of the program at ICMR and CIHR all the success in implementation of the recommendations.

(VM Katoch)

# Message

**Bela Shah**
Scientist G & Head
Division of Noncommunicable Diseases
Indian Council of Medical Research, New Delhi, INDIA

The ICMR and CIHR signed the Memorandum of Understanding (MoU) to collaborate and work together in several areas of health research. This has great relevance in view of a large Indian community in Canada. This workshop was held as the first activity towards this agreement.

The global spread of obesity is likely to affect India in a big way unless it is halted. The country has an unfinished agenda of undernutrition, and is now facing the double burden with rising prevalence of overweight/obesity as shown by repeated National and local level surveys. There is a high burden of Noncommunicable diseases (NCDs) eg. Heart diseases, hypertension, stroke, diabetes, cancers amongst the adult population. Obesity is an important under-runner in the development of most of the NCDs. The Council has addressed the related NCD research issues through its own Institutions and by funding individual investigators from various institutes in the country over several decades.

Recognizing the timeliness of scaling up research in childhood obesity, this endeavor invited participants from a wide range of expertise from India and Canada on a common platform to present, discuss and suggest areas of collaborative research for investigators from both countries. The wide canvas for research will encourage multi-disciplinary approaches to address surveillance, determinants, genetic/epigenetic, animal studies, study of behavioral and societal aspects so as to improve overall health.

I am confident that investigators from India and Canada will benefit from mutual expertise and resources to address global issues while achieving national goals. The cooperation of the CIHR team leaders and participants for developing a long term research agenda on childhood obesity is highly appreciated.

# Message

**Michael S. Kramer,**
Scientific Director,
Institute of Human Development, Child and Youth Health,
Canadian Institutes of Health Research, CANADA

International partnerships are of core importance to CIHR, and to IHDCYH in particular. Collaboration with international partners provides access for Canada's health research community to international knowledge networks and helps strengthen Canada's scientific, cultural, political, and commercial links to nations in the developed and developing world.

CIHR's collaboration with India started in 2005 with the signature of a Memorandum of Understanding with the Indian Council of Medical Research to fund health research collaboration between Canada and India. Obesity was identified as one of areas of common interest. The causes and prevention of child obesity is one of IHDCYH's strategic priorities, and this joint workshop has been the first concrete step toward implementing the ICMR-CIHR collaboration. Investigators from both countries exchanged knowledge and ideas, ranging from fetal and early child antecedents of obesity to the evaluation of preventive interventions at the family, school and community levels.

The Canadian delegation was extremely warmly received and hosted by the ICMR Coordinators. They have been extraordinarily enthusiastic about our collaboration. I also want to thank the Canadian investigators who attended the workshop for their time, effort, and active participation in helping us design a collaborative funding program. I am confident that the program will lead to excellent science and aid both countries to understand the causes and mechanisms underlying the epidemic of obesity in both countries, and to formulate strategies and policies to combat the epidemic.

# Introduction & Background

The Indian Council of Medical Research (ICMR), New Delhi and the Canadian Institutes of Health Research (CIHR), Ottawa expressed a common interest for cooperation for research in health research areas of common interest. This interest was formalized through the signing of a Memorandum of Understanding (MoU) by Prof. NK Ganguly, Director General, ICMR and Dr. Alan Bernstein, President, CIHR on 13th January 2005 in New Delhi, INDIA. The major research areas identified in the MoU were as:

1. Lifestyle Diseases
2. Public Health
3. Disease Surveillance

The activities for fulfilling these objectives could be exchange of Scientists, scientific information, technical data, publications etc. through lectures/workshops/seminars. A Joint Steering Committee consisting of Members from ICMR and CIHR was created to guide and monitor the implementation of the MoU through established mechanisms.

In October 2006, an ICMR delegation of experts led by Dr Bela Shah, Head, Division of Noncommunicable Diseases, ICMR visited CIHR and several Canadian institutions and held discussions with key investigators in the identified research priority areas. Childhood obesity was one of the areas in which experts from both countries desired to work together and organizing a collaborative workshop in India was identified as a starting point.

In May 2008, Dr Michael Kramer, Scientific Director, CIHR- Institute of Human Development, Child and Youth Health (IHDCYH), Montreal contacted ICMR to explore the possibility of organizing a workshop on childhood obesity in India. Through deliberations, it was agreed that a workshop on “Childhood Obesity and Noncommunicable Diseases” would be held on 14-16th January 2009 in India, wherein a delegation of Canadian and Indian experts would be invited to participate and identify a research agenda for planning future collaborative research proposals.

Several rounds of teleconference discussions were held by the workshop coordinators from CIHR (Dr Michael Kramer and

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Program Officer, Obesity & Metabolic Syndrome
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**Anne-Cécile Desfaits**
Assistant Director
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Dr Anne Cécile Desfaits) and ICMR (Dr Bela Shah and Dr Prashant Mathur). Experts from both countries provided their inputs. The agenda was finalized during the visit of Dr Prashant Mathur to Montreal in November 2008. It was agreed that clinical and therapeutic approach would not be included in the focus of the workshop and collaborative research program. Instead, the focus would be on on the causes and prevention of childhood obesity, for which four theme areas were identified:

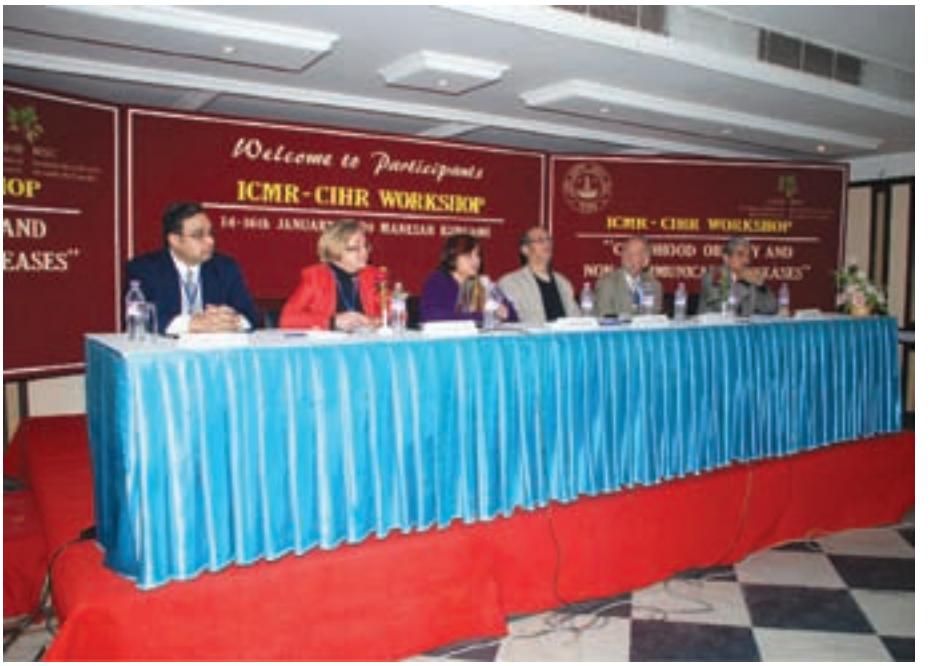
1. Epidemiologic transition & its consequences
2. Early origins of obesity
3. The obesogenic environment during childhood and adolescence
4. Public health interventions to tackle the obesity epidemic

At the inauguration function held on 14th January 2009, Dr NK Arora (INCLEN Trust, New Delhi) and Dr Laurette Dubé (McGill University, Montreal) delivered keynote addresses on "Fundamental drivers of optimal weight, shape and health: A non-communicable diseases perspective". Dr VM Katoch, Secretary, Department of Health Research & Director General, ICMR gave the inaugural address and emphasized on collaborative research in areas of mutual interest so that both partners benefit.

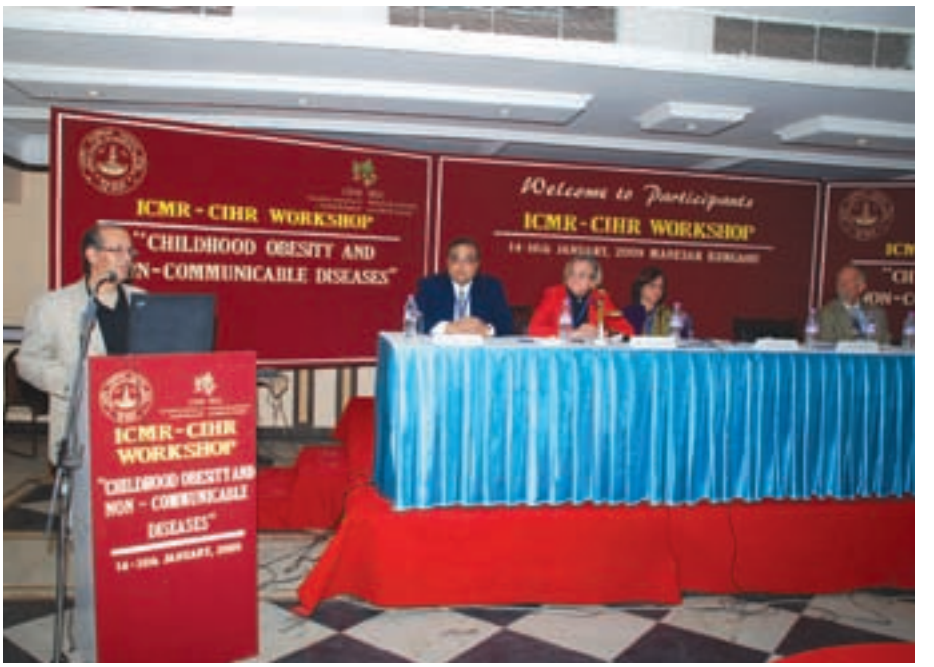
During the next 2 days, introductory talks were given on each of the identified themes of the workshop by speakers from Canada and India. Two concurrent working group sessions were held (as per agenda enclosed) in which the participants discussed the available evidence and identified important research issues. The working group recommendations were presented and discussed in plenary sessions and were modified accordingly. The representatives from ICMR and CIHR held an in-house meeting to discuss the operational issues in implementing the MoU. It was agreed that based on the recommendations of this workshop, a joint call for proposals will be posted in both countries, wherein collaborative research projects can be submitted from any interested investigator on either side, and not just restricted to the participants of this workshop. ICMR and CIHR will fund their respective investigators. A mutually agreed-upon mechanism for monitoring these projects will also be put in place. This workshop report should facilitate the investigators in developing their projects.

The workshop closed with thanks to all participants and the organizers.

# At the Inaugural Function of the Workshop, 14th January 2009




Left to right: Prashant Mathur, Laurette Dube, Bela Shah, VM Katoch, Michael Kramer, NK Arora




Dr VM Katoch, Secretary, Department of Health Research, Govt. of India & Director General, ICMR welcoming the participants of the workshop, 14th January 2009

# KEYNOTE ADDRESSES

## Fundamental drivers of optimal body weight, shape and health: A Noncommunicable disease perspective


**Narendra K. Arora**
Executive Director,
The INCLEN Trust International
New Delhi


**Laurette Dubé**
James McGill Chair, Consumer and Lifestyle Psychology and Marketing,
And Full Professor, Desautels Faculty of Management (Marketing), McGill University,
Montreal, Canada

**Narendra K. Arora**
Executive Director,
The INCLEN Trust International
New Delhi

Lifestyle diseases like obesity are outcome of complex interaction between human biology, behavior and society. The complex causal web for obesity developed by Foresight Initiative in UK has identified various domains; physiology modified by food consumption, physical activity behavior, psychology of the individual, which in turn are influenced by food production, its availability and the environment (built environment, social psychology and policy).

The data presented was from SRS-Survey, industry research and from specific Ministries of Government of India. This discussion focused on the drivers of body weight, shape and health in the Indian context.

Food Consumption Pattern: Caloric consumption in India has reduced in both rural and urban areas over last 30 years. In the states with high Human Development Index (HDI > 0.65) people have higher per capita consumption (1.5-2 times) of milk products, sugar and fat as compared to those residing in states with low HDI. It appears that in both urban and rural areas, changes in food consumptions pattern are more a reflection of economic class rather than the place of residence of the people.

India is currently seen as a mass market for food products. Compared to the neighboring countries, in India the demand for milk products vegetables and fruits is likely to rise significantly by 2025. Market research on purchase of consumer products suggest that by 2015 the beverages and processed snack food purchase is expected to be doubled. The Indian food industry, especially the informal sector is not regulated about the quality of food. Several traditional Indian fast foods have high trans-fatty acid contents. India is one of the largest importers of palm oil and provides large subsidy on palm oil, influencing the price and consumption.

Urbanization is growing consistently over the years and so is the motorized transport mode. The worrying part is gradual erosion of pedestrian paths by the roads and parking lots to accommodate the increased vehicular load in major urban centers.

Media: Almost 50% of advertisements during children's program on television are related to food products. There are no definite food standards regulations or advertising or marketing regulation in India.

Education: Indian children are burdened with the competition for

academic excellence at the cost of physical activity. A significant proportion of the schools are ill equipped to promote structured physical activity. In the residential areas also there is insufficient scope for play of the children.

Biology: The Indian newborns, children and even adults have higher body fat compared to the Caucasians of similar body weight or even lower weight. This makes us biologically more prone for the body fat related diseases.

Policy Dilemma: Over the years proportion of low birth babies has stagnated at about 30%. Almost half of our children are stunted and under weight. This puts the policy makers in a dilemma for formulating food and nutrition policy tackling the whole spectrum of nutrition problems.

## Conclusion

Biology (gene) does not change over short time span, but the emergence of the obesity and other chronic diseases force us to think about environmental drivers of body fat. The world is moving towards high technology driven lifestyle, which is unlikely to roll back. Every individual in the society is exposed to these influences willingly or unwillingly and will experience the consequences even unknowingly. A systematic multi-sectoral approach with population health as a key outcome is urgently required to influence policy and influence the emerging epidemic of obesity and other chronic diseases.

The keynote address laid out the foundation of an approach to childhood obesity that see a complex interplay between biology, behavior and environment as both causal root to the pandemics and the way forward to curb its progress. This has been the scientific anchor of a series of knowledge-to-action think tanks on childhood obesity hosted at McGill University (www.mcgill.ca/healthchallenge). These have harnessed the world's best minds and leading organizations in health and nutrition, agriculture, education, urban planning, finances, marketing, and economics, to build synergy among business, markets, government and civil society to fight childhood obesity in developed and developing countries.

The presentation reviewed concepts, best practices and novel frameworks that are critical in creating environmental conditions that don't present too much challenge for biology and support healthy choice at the individual level. These include:

1. Interventions targeting behavioral changes as the individual level
2. Societal action to improve professional judgments and strategic choices made by school, health, agriculture, business and other organizations in social and economic domains,
3. Choices of policy instruments made by governments to enable innovation and action by individuals and all actors in society

## Conclusion

Develop and synthesize through systems analysis, knowledge that will drive policy in health and economic domains and inspire social and business innovation that can help reach the balance of environmental opportunities and constraints that makes health the easiest and most sustainable option for individuals and society alike.

**Laurette Dubé**
James McGill Chair, Consumer and Lifestyle Psychology and Marketing,
And Full Professor, Desautels Faculty of Management (Marketing), McGill University, Montreal, Canada

# **Session I :**
# Epidemiologic Transition and its Consequences

# Area-level influences related to obesity and cardiometabolic diseases: environmental factors and their mechanisms

**Mark Daniel**
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(Population Health)
Département de médecine sociale et préventive,
Faculté de médecine
Université de Montréal, CANADA

Prevalence rates of obesity/overweight have risen in Canada and will grow higher with an increasing prevalence of overweight/obesity among youth. Societal shifts to greater intake of energy-dense food and reduced energy expenditure underpin rising rates of obesity around the globe. These risk behaviours do not arise in a vacuum.

A large literature concedes the role of environmental factors in predisposing, enabling and reinforcing risk behaviours for overweight/obesity. Neighbourhood disadvantage has been linked to unhealthful dietary behaviour, reduced physical activity and higher risk of cardiometabolic diseases. Associations between neighbourhood disadvantage and unhealthful diet and activity level are partly explained by residential variations in sources of healthful food, and built environmental factors affecting opportunities for planned or recreational physical activity. Availability of environmental resources has also been shown to be associated with overweight/obesity, and greater mortality and rates of admission for acute coronary syndromes. The availability of environmental resources has been clearly shown to vary with neighbourhood characteristics. Studies in the US indicate that disadvantaged neighbourhoods and high numbers of minorities have a lower availability of stores selling healthful foods, greater availability of fast-food outlets, and lesser opportunity for physical activity than advantaged residential areas or those with fewer minorities. Research in Canada, the UK, Australia, and New Zealand has similarly indicated that area-level socio-economic status (SES) is inversely related to the density of fast-food outlets and positively to physical activity opportunity. The inverse relationship found in the US between area disadvantage and stores offering healthful foods has not, however, been observed by studies in the UK or Australia. Canadian studies have noted spatial variations in access to sources of fruits and vegetables, and such disparity has not been clearly explained by area

SES. These approaches will inform public health and urban planning action to reduce unhealthful or enhance healthful commercial presence related to obesity and disease in particular areas.

## Research Needs:

1. Investigate true environmental factors (e.g., availability of food sources and physical activity opportunity) and their spatial variations that impact behaviour, obesity/overweight, and cardiometabolic outcomes in addition to, or interactively with, neighbourhood SES: Socio-demographic indicators beyond SES, including family structure and size, marital status, immigration status, and urban form indicators, including residential density, waterways, roadways, obstructions to movements, and aesthetic features including green space, are especially relevant for research attention as such factors can conditional social and cultural norms or options for eating and physical activity level. Areas defined by social or built environmental risks can be targeted for multi-level health intervention to change places and the behaviour of people in these places.
2. To study the correlates as well as the causal direction of relationships, so as to make the behavioural, psychosocial, and the direct biological pathways by which environments influence health outcome explicit.
3. The need is to contextualize our individual level knowledge to act on the environmental drivers of sick populations.

## Suggested reading

1 Daniel M, Moore S, Kestens Y (2008). Framing the biosocial pathways underlying associations between place and cardiometabolic disease. Health and Place 14:117-32

2 Morland K, Diez Roux AV, Wing S (2006). Supermarkets, other food stores, and obesity the atherosclerosis risk in communities study. American Journal of Preventive Medicine 30(4):333-9.

3 Auchincloss AH, Diez Roux AV, Brown DG, et al. (2008). Neighborhood resources for physical activity and healthy foods and their association with insulin resistance. Epidemiology 19:146-57

# Ethnic heterogeneity of obesity in Canada

**Scott A. Lear**
Associate Professor, School of Kinesiology, Simon Fraser University
Adjunct Professor, Division of Cardiology, University of British Columbia

Over the past 30 years, the prevalence of obesity (body mass index ≥30 kg/m2) in adults living in Canada has increased to 23.1%. This has been paralleled by a concomitant increase in obesity in children to 18%. As Canada is a country of many cultures, these prevalence rates do not tell the whole story as the prevalence of obesity can vary by more than seven-fold comparing those of East/Southeast Asian to those of Aboriginal origin. In children of East/Southeast Asian origin, the prevalence of obesity is approximately 12%.

As of 2006, those identifying themselves as being of South Asian origin were the largest self-identified minority group in Canada at over 1.2 million. Of greater importance is that the increase in this population from 2001 to 2006 was nearly seven-fold of the general population. It is expected that this population will grow even more in the future, therefore, the health of South Asians is of great importance to Canada.

Previous research has identified potential differences in body composition among ethnic groups which is important for the development of targeted prevention strategies. In comparing the body composition of men and women of European and South Asian origin living in Canada, we reported that South Asians have a higher percentage body fat, visceral adipose tissue, deep subcutaneous adipose tissue and less lean mass than the Europeans. These differences were apparent even taking into consideration demographics, lifestyle parameters and body size. This would indicate that with the increasing prevalence of obesity in those of South Asian origin, the burden of type 2 diabetes and cardiovascular disease will likely be much higher than in Caucasian populations, necessitating the development and implementation of appropriate obesity prevention strategies.

## Research Needs:

1. What are the obesity trends in children of different ethnicity?
2. Are measures of abdominal obesity more effective for identifying at risk populations?

3. Are there ethnic differences in body fat distribution in children?
4. What are the determinants (genetic, environmental) of ethnic differences in body fat distribution?
5. At what stage in life are ethnic differences in body fat distribution present and do they change over time?
6. Do these ethnic differences translate into obesity-related morbidities and mortality

## Suggested reading:

1. Lear SA, et al. Am J Clin Nut. 2007;86:353-359.
2. Lear SA, et al. Obesity. 2007;15:2817-2824.
3. Shields M. Measured obesity: Overweight Canadian children and adolescents. Statistics Canada 2005.

# Epidemiological transition: An Indian perspective

**Prashant Mathur**
Scientist D
Program Officer, Obesity & Metabolic Syndrome
Division of Noncommunicable Diseases
Indian Council of Medical Research, New Delhi

Overweight and obesity in childhood is increasing at an alarming rate in the developed countries, and the same is expected to happen in developing economies as their prosperity rises. These countries are amidst an epidemiological transition from undernutrition to overweight and obesity. This transition needs to be looked along with the distally occurring demographic, economic, social and nutritional transition; proximal health related nutritional, disease profile and health care and the outcome transition in terms of underweight/overweight and obesity.

Over the past several decades, India has been seeing an increasing population, literacy, urbanization, consumption of fat in food items, physical inactivity, rise in heart diseases, diabetes and other major Noncommunicable diseases in adulthood, and concomitant with declining energy intake, stunting and underweight in children. There is lot of heterogeneity in these parameters in the urban, rural, age groups in various regions of the country. These can be attributed to the use of different methods to measure and classify anthropometry findings, selection of study population, and lack of prevalence trends in the same population. Studies done at several places across the country showed rising overweight and obesity rates, especially among the urban population. The recent surveys (2005-06) of NNMB and NFHS have shown overweight across the age groups. However, ratio of prevalence of underweight to overweight is estimated for NFHS and NNMB surveys amongst the childhood population, remains below 1. In district Ernakulum, Kerala, more than 20,000 school going children aged 5-16 years had their anthropometry measured twice- in 2003-04 and 2005-06 under the ICMRs registry on Rheumatic fever/heart disease. Overweight and obesity increased from 4.6% to 6.5% in these 2 years, while a 2-3% decline in undernutrition was also seen.

Thus, the settings for an epidemiological transition from underweight to overweight and obesity are occurring, but prevalence data does not show uniform shifts across the populations. It is appropriate time to put effective strategies in place to check the rise in overweight and obesity amongst children.

## Research Needs:

1. Identification of simple and valid indicators for tracking epidemiological transition: anthropometry, nutrition profiling, socio-economic parameters etc.
2. Correlate these changes to Noncommunicable diseases morbidity and mortality patterns so as to understand the consequences of this transition.

# Cardio-metabolic risk of epidemiologic transition

**Anoop Misra**
Director and Head, Department of Diabetes and Metabolic Diseases Fortis Hospital, Vasant Kunj, New Delhi

The prevalence of obesity and the metabolic syndrome is rapidly increasing in developing countries, leading to increased morbidity and mortality due to type 2 diabetes mellitus (T2DM) and cardio-vascular disease (CVD).

With improvement in economic situation in developing countries, increasing prevalence of obesity and the metabolic syndrome is seen in adults, as well as in children. The main causes are; increasing urbanization, nutrition transition, and reduced physical activity. Some evidence suggests that widely prevalent perinatal undernutrition and childhood 'catch-up' growth may play a role in adult-onset metabolic syndrome and T2DM.

Some of the important characteristics of Asian Indians which predispose them to develop hyperglycemia and atherosclerosis are; excess adiposity, high subcutaneous and intra-abdominal adipose tissue, insulin resistance and the metabolic syndrome, hepatic steatosis, sub-clinical inflammation and endothelial dysfunction. Some of these manifestations appear at birth or early childhood. Further, in Asian Indians, cardiovascular risk manifests at a lower level of adiposity and abdominal obesity. Such cardiovascular risk profile has been increasingly reported in economically disadvantaged people in rural areas and urban slums. In such populations, risk factor profile is continuosly changing and becoming increasingly adverse.

## Research Needs:

1. Characterize the cardio-metabolic risk related to obesity and epidemiological transition in various population categories (ethnicity, age groups, geographic distributions etc).
2. Develop a comprehensive intensive risk reduction package through a life cycle approach

# **Session I :**
# Epidemiologic Transition and its Consequences

## WORKING GROUP REPORTS

1. **Working Group - I**

# Surveillance of obesity and its determinants in children and adolescents

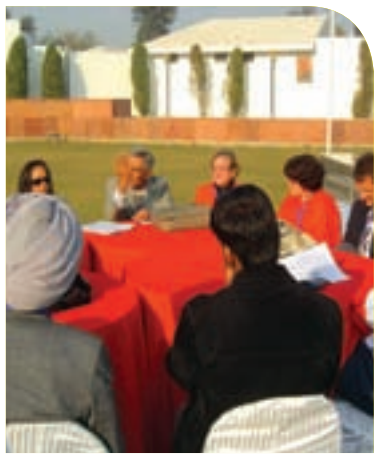
Surveillance in the context of overweight and obesity would aim at determining its trends over a period of time as well the determinants at multiple levels. There are no specific programs in India and Canada for the said purpose. However, existing health surveys/ programs could include the selected parameters. In India, data on school health does not have wide coverage and accessibility. There is need to identify simple and valid indicators to measure obesity, adiposity and a few novel makers (eg. Body image) to facilitate tracking its changes. This system should also monitor trends of the associated co-morbidities during the life span and relate it to changes in obesity and adiposity.

## Recommendations:

1. Establish surveillance mechanisms based on valid parameters which are locally relevant and globally comparable.
2. Identify the tools and methods for planning, data collection, monitoring and assessment.
3. Monitor outcomes of changing obesity and its co-morbidities
4. Assessment of existing growth standards for monitoring growth from early infancy onwards to their relation to specific health outcomes, and the need to develop more specific ones.

**2. Working Group - II**

# Double burden and its relevance to developing economies



The co-existence of undernutrition and overnutrition at population level poses a unique public health challenge. The problem is more relevant to India than Canada. However, migration of population within India and from India to Canada is a form of epidemiological transition and puts forth double burden problems. The Indian population is multi-ethnic and transitioning at different rates. Comparisons between Indians living in Canada and the non-Indian ethnic population would provide useful insights.

## Recommendations:

1. Study co-existing undernutrition and overnutrition (obesity) within the ethnic heterogeneities within each Country and amongst population migrating from developing to more developed environments.
2. Determine the healthy and unhealthy trajectories of growth in children, their outcomes and differences in India and Canada
3. Identify appropriate methodologies for research in the Indo-Canadian context: i.e.: qualitative research- experiences of children, building consortium of existing cohorts, physical activity

# Session II :
## Early Origins of Obesity

# Fetal origins of obesity

**K.S. Joseph**
Department of Obstetrics & Gynaecology and Pediatrics
Dalhousie University and the IWK Health Centre, Halifax, Canada

The epidemic of obesity as observed globally and the increasing interest in the fetal origins of adult disease has led to numerous studies examining the role of fetal factors in the development of subsequent obesity.

Most studies show a direct relationship between birth weight and obesity, with higher birth weight associated with higher mean body mass index (BMI) and higher rates of obesity among children and adults. There appears to be an approximately 0.5-0.7 kg/m2 increase in mean BMI for each 1 kg increase in birth weight. Child obesity is also associated with parental obesity, though the association between birth weight and BMI is only partly explained by a higher maternal BMI. Another factor associated with child and adult obesity is exposure to hyperglycemia in utero (i.e., maternal diabetes mellitus). Although many studies show a direct relationship between birth weight and obesity, several studies also show that low birth weight is associated with higher rates of central obesity. Recent studies show that infants born preterm and small-for-gestational age are particularly at risk for a larger waist circumference and a higher BMI.

Various explanations have been offered to explain these associations. The association between birth weight and obesity may be explained by genes that have effects on both birth weight and obesity. The association between parental and child obesity can be explained by similar prenatal and postnatal eating habits. Finally, it is possible that fat cell size/number is determined in utero.

## Research Needs:

1. What are the trends in low birth weight, preterm birth and SGA in India?
2. What are health vs unhealthy trajectories of growth e.g., will preterm SGA infants who have a healthy diet and adequate physical activity have central obesity?
3. Does the pathway between low birth weight and poor cardiovascular health flow through obesity?

## Suggested reading

1. Oken E, Gillman MW. Fetal origins of obesity. Obes Res 2003;11:496-506.
2. Evensen KA, Steinshamn S, Tjønna AE, et al. Effects of preterm birth and fetal growth retardation on cardiovascular risk factors in young adulthood. Early Hum Dev 2008 Nov 12.

# Childhood obesity & maternal influences

**Chittaranjan S Yajnik**
Director,
Diabetes Unit,
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Pune

The epidemic of Obesity is becoming prominent in low-middle income countries. Recent research findings of adiposity being programmed in the intrauterine life, and the role of genetic and epigenetic factors offer a unique opportunity for its early prevention.

Current definitions and cut offs for defining limit comparisons across populations as well as assessment of adiposity. The higher body fat percent (adiposity) in Indians for any given BMI compared to Europeans, leads to higher risk of metabolic and vascular problems at lower BMI. This has led to the concept of 'thin fat' Indians. Using some of the anthropometry and imaging techniques, Indian newborns are shown to be 'thin and fat' as compared to European babies. Fetal programming influences future health and susceptibility to disease, and Maternal nutrition and metabolism are two prominent stimuli for it. These influences interact with fetal genome and modify gene expression without any change in base sequence of DNA (Epigenetics). Methyl donors like folate and vitamin B12 play a pivotal role in epigenetic changes. Another possible mechanism of epigenetic change is through maternal metabolism, highlighted in studies of diabetic pregnancy. Norbert Frienkel developed the concept of 'fuel-mediated teratogenesis' to describe a spectrum of fetal outcomes in diabetic pregnancy (early fetal wastage, birth defects, affection of brain function and adiposity and risk of diabetes). We have extended this thinking to the spectrum of affection by 1-C (methyl) metabolism and called it 'nutrient-mediated teratogenesis'. Both are associated with changes in body composition (adiposity) and metabolic programming which predisposes to insulin resistance, B-cell dysfunction and type 2 diabetes. The Pune Maternal Nutrition Study has shown that maternal vitamin B12 deficiency coupled with folate excess is associated with offspring adiposity and insulin resistance. If the epigenetically affected offspring is female, then she transmits the susceptibility to her children (transgenerational amplification of obesity and diabetes). In India, rapid transition seems to have combined the nutrient-mediated and fuel-mediated teratogenesis to cause a rapid rise in prevalence of adiposity and

diabetes in the young, including children. Rapid childhood growth in Intra Uterine Growth Retarded (IUGR) babies is associated with increased adiposity and insulin resistance and increased levels of cardiovascular risk factors. This finding is counterintuitive to current practice of rehabilitation of low birth weight children by feeding them to achieve 'normal' growth and needs to be further investigated.

## Research Needs:

1. Need for a life-cycle based approach to health and disease prevention. This should begin very early in the life-cycle and many will have effect only intergenerationally.
2. Investigate the needs and methods of supplementing protein and micronutrients
3. Rationalisation of growth charts with adult outcomes in mind.
4. Nutritional rehabilitation of IUGR children

## Suggested reading :

1. Yajnik CS, Fall CHD, Coyaji KJ, etal. Neonatal anthropometry: The thin-fat Indian baby, The Pune Maternal Nutrition Study. International Journal of Obesity 2003; 26:173-180.
2. Yajnik CS, Deshpande SS, Jackson AA, etal. Vitamin B12 and folate concentrations during pregnancy and insulin resistance in the offspring: The Pune Maternal Nutrition Study. Diabetologia 2008; 51:29-38
3. Yajnik CS. Nutrient-mediated teratogenesis and fuel-mediated teratogenesis: Two pathways of intrauterine programming of diabetes. Int J Gynaecol Obstet. 2009 Jan 17.

# Role of infant feeding in the obesity epidemic

**Michael S. Kramer**
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The main controversies in this area concern the effects of early growth (especially weight gain) and breastfeeding.

Infant feeding is a potent determinant of the growth rate in the early weeks and months of life. IGF-I, the principal hormone affecting growth in infancy, is responsive to both the energy and protein concentration of the diet. Lucas, Singhal, and colleagues from the U.K. argue from both animal studies and their own follow-up studies of children, that rapid early infant weight (especially in the first 3 months) increases the risk of obesity and insulin resistance in later childhood and adulthood. Barker, Ericsson, et al from Finland, however, have reported that low, rather than than high, weight gain in the first 2 years of life is associated with future risk. Cohort studies from both Pune and Delhi suggest that rapid weight gain in later childhood is associated with these risks.

Although infants who receive prolonged and exclusive breastfeeding have been reported to grow more slowly than those who are formula-fed or who are weaned early, the causal nature of this association remains controversial. A meta-analysis based on individual patient data suggests that breastfeeding affords little or no long-term protection against obesity, an inference also supported by the cluster-randomized PROBIT trial from Belarus.

## Research Needs:

1. RCTs of energy and/or protein supplementation of breastfed SGA infants
2. RCTs of high-energy, low-bulk complementary foods in poor rural settings
3. Epigenetic effects of breast- vs formula feeding

## Suggested reading:

1. Chomtho S, Wells JCK, Williams JE, etal. Infant growth and later body composition: evidence from the 4-component model. Am J Clin Nutr 2008;87:1776-1784.
2. Owen CG, Martin RM, Whincup PH, etal. The effect of breastfeeding on mean body mass index throughout life: a quantitative review of published and unpublished observational evidence. Am J Clin Nutr 2005;82:1298-1307.
3. Kramer MS, Matush L, Vanilovich I, etal Effects of prolonged and exclusive breastfeeding on child height, weight, adiposity, and blood pressure at age 6.5 years: New evidence from a large randomized trial. Am J Clin Nutr 2007;86:1717-1721.

# Infant nutrition and later obesity: An Indian perspective

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Recently, four systematic reviews from observational studies have summarized information on the association between infant feeding and later obesity. These studies were primarily from developed countries, evaluated children, adolescents or adults and usually compared breast versus formula feeding. Information was invariably incomplete with respect to infant feeding exclusivity, duration and introduction of semi-solids. Confounder adjustment was infrequent and the most common evaluated outcome was body mass index (BMI) rather than firmer measures of adiposity like skinfold thickness, bio-impedance or DEXA.

The reviews suggested a protective effect of breastfeeding for later obesity; ~20% for exclusively breast-fed versus formula fed infants. There was some evidence of a "dose response effect" – longer duration of breast-feeding had greater effect (4% lower risk per month of breast-feeding) but there was no relation with mean BMI. Confounder adjustment attenuated all relationships. A study documented an inverse association of breast-feeding with fat mass (DEXA) at 9-10 years age. There was virtually no information on: (i) Effects of different formulas; (ii) Age of starting solids; (iii) Type and quality of complementary feeds; and iv) Micronutrient supplements.

A similar analysis was done on the New Delhi Birth cohort when subjects were between the ages of 28 and 32 years. During infancy, over 99% of them received breast-feed while the exact duration of breast-feeding was not recorded. Delayed introduction of semi-solids (beginning from 7-9 months was associated with a significantly lower (confounder adjusted) adult waist circumference, BMI and overweight but not fat percentage or skinfold thickness. However, there was no significant relationship with blood pressure, hypertension, impaired glucose tolerance or diabetes. Accelerated growth in the first 2 years of life was more correlated with adult lean tissue mass rather than sum of skin-folds.

## Research needs :

(i) Relating the childhood cohort study data to adult DEXA measures

(ii) Conducting similar analyses on recent observational trials of growth with detailed infant feeding information and on randomized controlled trials of infant feeding and single micronutrient interventions

(iii) Relating early infant growth to adult adiposity measures. Efforts should be directed towards extraction of meticulous feeding definitions, firmer measures of adiposity and adult metabolic disease markers.

(iv) Evaluating potential hormonal mechanisms.

# Animal models to understand the obesity epidemic Neonatal ghrelin and sensitivity to high fat diet in adulthood

**Jean-Pierre Chanoine**
Endocrinology and Diabetes Unit,
British Columbia Children's Hospital,
University of British Columbia, Vancouver,
Canada

Animal studies are an integral part of obesity research. Identification of new genes promoting weight excess or protecting against it and testing of novel hypotheses related to gene-nutrient interactions are two of many opportunities offered by animal models. A brief summary of one animal model used at the Child and Family Research Institute in Vancouver is discussed as a potential offered by laboratory research in general and animal studies in particular for scientific collaboration between India and Canada.

The objective of our research program is to investigate in rodents the role of ghrelin, a 28-amino acid peptide secreted primarily by the pancreas in the fetus and the neonate (and by the fundus of the stomach in adult animals) in the development of obesity. We hypothesize that administration of acylated ghrelin prior to weaning (during the 2nd postnatal week) will affect the sensitivity of the adult animal to the obesogenic effects of high fat diet. Ghrelin circulates as acylated and desacyl forms. Acylation of Ser3 by n-octanoic acid is required for binding of ghrelin to the growth hormone secretagogue receptor (GHS-R). Exogenous administration of acylated [but not desacyl] ghrelin stimulates GH secretion, inhibits insulin secretion and increases appetite through binding to GHS-R. Both acylated and desacyl ghrelin decrease adipogenesis through GHSR-independent pathways. Animal knock-out models of ghrelin (ghrl-/-) are resistant to the development of obesogenic effects of high fat diet if the high fat diet is started at weaning, which may suggest developmental issues. After investigating the characteristics of ghrelin metabolism in mice during the perinatal period, we will compare the effects of acylated ghrelin, desacyl ghrelin and a ghrelin antagonist, administered during a critical period of brain development (2nd postnatal week) on the effects of a high fat diet (started at weaning) on weight, body composition, energy expenditure and hormonal profile.

## Research Needs:

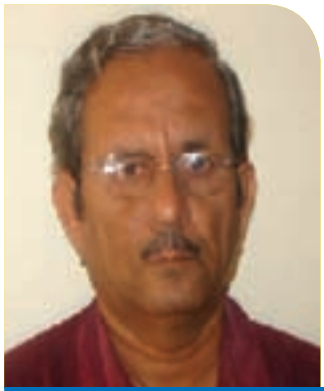
The use of animal models for the study of obesity poses challenges and offers opportunities for collaborative projects at several levels:

1. Type of intervention
   - Genetic, nutritional, hormonal, behavioural or others
2. Timing of intervention
   - Prenatal factors; maternal undernutrition, maternal high-fat diet feeding, maternal stress during gestation
   - Postnatal factors; changes in the composition or amount of maternal milk, maternal-pup behavioural interactions
3. Mechanisms of action; eg. increased maternal milk intake
4. Its relevance to human conditions?

## Suggested reading:

1. P Walia, A Asadi, J Johnson, T Kieffer and JP Chanoine. Ontogeny of Ghrelin, Obestatin, Preproghrelin and Prohormone Convertases in Rat Pancreas and Stomach. Pediatr Res. 2009 Jan;65(1):39-44
2. JP Chanoine. Ghrelin in growth and development. Horm Res. 2005;63:129-38 (Review)
3. JP Chanoine and ACK Wong. Ghrelin gene expression is markedly higher in fetal pancreas compared with fetal stomach: effect of maternal fasting. Endocrinology. 2004;145:3813-20

# Animal models to understand the obesity epidemic



**Manchala Raghunath**
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National Institute of Nutrition, Hyderabad

Overweight and obesity are problems of global importance. Among its several aetiological various factors, altered developmental programming due to maternal under-nutrition is of particular relevance to India considering the widespread under-nutrition [specially of micronutrients (MNs)] among adolescent Indian girls, pregnant and lactating mothers. Assessing the importance of maternal MN deficiency in modulating developmental programming for obesity in later life of the human offspring is difficult. Therefore appropriate animal models have been in use for this purpose. The effects of maternal MN deficiency (Hidden hunger - widely prevalent in India) on developmental programming for obesity and associated diseases in later life are little understood.

We investigated in the Wistar / NIN rat model, whether or not maternal MN deficiencies modulate body composition (adiposity and lean body mass) in the offspring which could predispose them to adult onset diseases. Our initial studies showed that maternal vitamin or mineral restriction increased body fat %, decreased lean body mass (LBM), fat free mass (FFM) and impaired the offspring's capacity to secrete insulin to a glucose challenge. Similar changes were seen in the offspring of Mg, Cr, Zn, folic acid and / or vit B12 restricted rat dams. Although maternal Mn restriction altered only body fat % and plasma lipid profile in offspring, it increased their susceptibility to impaired glucose metabolism on feeding high fat diet in later life. In general, increased body fat % was associated with increased central adiposity, altered lipid profile and expression of adipokines. Decreased LBM % and FFM % were associated with altered myogenic gene expression and glucose uptake by muscle indicating altered muscle development and function. Alterations seen in fasting plasma insulin and insulin secretion to a glucose challenge probably suggest alterations in carbohydrate metabolism. Considering that the phenotypic changes in offspring were mostly irreversible by rehabilitation from as early as birth ( in line with Barker's hypothesis), our studies demonstrate the utility of animal models in deciphering the role of maternal micronutrient deficiencies on childhood obesity.

## Research Needs:

1. To study the importance of experimental animal models in evaluating the effects of maternal micronutrient deficiency in the aetiology of obesity and associated diseases in the offspring.

# **Session II :**
# Early Origins of Obesity

## WORKING GROUP REPORTS

**1. Working Group - I**

# Fetal and infant origins of obesity

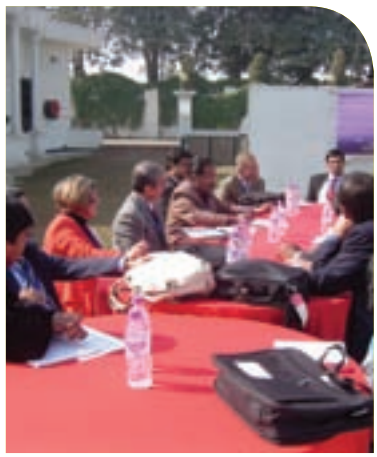
The group discussed the healthy and unhealthy child growth trajectories, longitudinal evaluation of body composition, Preterm/term, SGA/AGA, Indian/European, rural/urban differences, Cohort studies by socio-economic groups, role of micronutrient deficiency including Vitamin D, infant feeding and biomarkers of health in children at 2, 4 6 years of age, innovative markers of malnutrition in childhood and the need (outcome-based) for ethnic-specific fetal and infant growth standards?

## Recommendations:

1. Investigate the maternal attitudes towards infant (esp. LBW) feeding, more vs less fortification for Small for Gestational Age infants
2. Influences of Preconception health on fetal/infant outcomes
3. Investigate role of physical activity in maternal and pre-school settings so as to influence the 'Indian phenotype'

**2. Working Group - II**

# Genetics, epigenetics and animal models of obesity



The genetic and epi-genetic studies could investigate different populations in a different environment (eg. how environment affects epigenetic characteristics), similar populations/different environment (Indians in India and Canadian immigrants); different populations/similar environment (Indians and Canadians in Canada) and how does environment affect epigenetic characteristics in subsequent siblings from the same family (born in 2 different countries)

## Recommendations:

1. Strengthen Technical collaboration for exchange of technology/expertise (incl. animal models), student training, synergies to decrease cost of doing research, development of common methodology to facilitate phenotyping of individuals for genetic/epigenetic studies
2. Harmonization of Bio-Banking (including development of methodology for “non-blood” samples such as saliva)
3. Development of replication cohorts of subjects to confirm genome-wide studies performed in one population

# **Session III :**
# The Obesogenic Environment during Childhood and Adolescence

# The Nutrition transition and childhood obesity: Canadian perspectives

**Kim Raine**
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In Canada, child and youth overweight and obesity rates have risen dramatically over the past 25-30 years. For example, measured rates have gone from 12-30% (overweight) and from 2-10% (obesity) of 12-17 year olds and from 1980- 2004.There is a socio-economic gradient – obesity rates are higher in households with lower socio-economic status (particularly lower education levels). Unfortunately, there is no large scale, regular surveillance system of children's food intake in Canada (a major data gap).

Using the ANGELO Framework (Analysis Grid for Environments Linked to Obesity) of Swinburn, Egger & Raza, 1999, determinants of healthy/ unhealthy eating can be classified into the following environment types: physical, economic, socio-cultural and political. Physical environments refers to the availability of and accessibility to foods. Increasing amounts of food are available for Canadian consumption over the past few decades. The economic environment (financial factors) include factors such as the observation that in Canada, food is increasingly marketed as a profitable commodity, and higher cost for healthy foods are common. The sociocultural environment addresses the beliefs and values in a society. In Canada, Aboriginal Canadians are at significant risk for obesity, and increasing risk of obesity with length of immigration is observed in immigrant populations. The political environment refers to policies affecting availability of healthy (or unhealthy) food. There have been recent changes in various jurisdictions throughout Canada imposing school food policies which limit "junk" food.

## Research needs :

1. What are the mechanisms through which environment contributes to childhood obesity?
2. What are the implications of the nutrition transition on diet quality and micronutrient status?
3. What are the most appropriate and effective interventions to reverse the epidemic, and can India learn from Canada's experience to slow the progression of childhood obesity?

## Suggested reading :

1. Vallianatos, H., & Raine, K. Consuming Food and Constructing Identifies among Arabic and South Asian Immigrant Women. Food, Culture and Society, 11(3):355-373, 2008.
2. Raine, K. Determinants of Healthy Eating in Canada: An Overview and Synthesis. Canadian Journal of Public Health, 96 (Supplement 3): S8-S14, 2005.

# Nutrition transition in India

**Umesh Kapil**
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All India Institute of Medical Sciences,
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India is experiencing rapid Nutrition transition along with epidemiological transition. The incidence of communicable diseases is decreasing while the prevalence of non-communicable disease like cardiovascular diseases, diabetes, hypertension, obesity is increasing in epidemic proportions. As a part of Nutrition transition, there is an increase in urbanization leading to higher employment shift from agricultural sector to industry and service sectors, use of energy saving devices especially universal use of motor transport. These changes are leading to decrease in physical activities and thereby positive energy balance. Due to increase socio-economic development in the country, there is increase availability of foods at affordable prices leading to changes in dietary consumption patterns.

We have data on the body composition of Low Birth Weight (LBW), Small Gestational Age (SGA) born to undernourished mothers (suffering from chronic energy deficiency) which have been included in the cohort studies initiated during 1960s and 1970s. At present, the SGA and LBW are born to optimally nourished mothers. In India, we are observing the prevalence of over nutrition and under nutrition simultaneously in the same communities. Recent scientific reports have documented the prevalence of vitamin D deficiency (clinical and sub-clinical) amongst children in the range of 40 to 90% as well. The traditional Indian diet is cereal based, high in fiber, rich in micronutrients, low in fats and healthy. The pulses are the main source of protein of the low socio-economic group population. The production of pulses has decreased during last 30 years. It has been documented that there is a gradual decline in consumption of pulses by the low income group population. India is implementing two large food supplementation programs: i) Integrated Child Health Scheme (ICDS) between 6 months to 6 years and ii) Mid Day Meal for children in the age group of 6 years to 11 years. Under these schemes, food is provided to every child every day.

## Research Needs:

1. Assessment of body composition of low birth weight (LBW), small gestational age (SGA), born to optimally nourished mothers of various socio-economic classes and its determinants. In addition, research on body composition of Preterm new born to healthy mothers of affluent families which are delivering due to obstetrical interventions.
2. Role of micronutirents, especially Vitamin D in obesity.
3. Role of traditional diets and eating habits
4. Impact of low intake of protein on “muscle mass” of subjects belonging to low income groups.
5. Composition of food supplements provided under National programs so that the incidence of chronic Noncommunicable diseases in adults can be reduced.

# The Obesogenic environment during childhood and adolescence: Drivers of physical inactivity

**John C. Spence**
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Faculty of Physical Education and Recreation,
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Cultural evolution has resulted in innovative changes to the environment in which most people now live. Humans have found many different ways to reduce energy expenditure (e.g., motorized vehicles); at the same time, we produce, store, and consume more calories than ever before. It is suggested that increasing levels of obesity in developing countries are due to the 'nutrition transition' in which rapid changes in diet and physical activity related to economic development can put the health of populations at risk for obesity and related diseases. Very little information exists on the extent to which the nutrition transition has influenced the physical activity of children in India.

Given that physical and social environments affect the obesity status of populations, emigrating from one country to another may influence the bodyweight of individuals. Thus, one important question is whether the physical activity levels of Indian children and Indo-Canadian children vary as a result of where they live. To acknowledge the role of environment, Egger and Swinburn (1997) have conceptualized obesity from an ecological perspective. For both energy intake and physical activity, they identified socio-cultural factors and influences in the physical, economic, and political environments. Similarly, Davison and Birch (2001) proposed that becoming overweight in childhood is based on behavioural patterns such as physical inactivity and dietary intake which are shaped by characteristics of the child, family, and broader society. For instance, the design of the neighbourhood where Canadian children reside can have an influence on their physical activity (Holt et al., 2008) and risk for obesity (Spence, Cutumisu, Edwards, & Evans, 2008). Thus, the prevalence of obesity in any population is dictated by the environment in which people live.

## Research Needs:

Currently, little is known about how social and contextual factors influence the physical activity of children and adolescents living in developing countries. Thus, is useful to consider the following questions:

1) Are there differences in physical activity between children living in India and Indo-Canadian children, and does type of play (active vs. sedentary) vary by region (urban vs. rural) in India
2) What is the access to parks and playgrounds for Indian children? Is the school setting a critical factor? How does population density and the social and environmental factors influence access to space and physical activity?
3) Can a Report Card on Physical Activity for Indian Children be developed?

# Physical inactivity as a driver of obesity – The Indian perspective

**Mario Vaz**
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There is data which suggests that childhood overweight and obesity in India is high, at least in the urban, affluent population. However, there is very limited information on physical activity patterns in Indian children and the extent to which physical inactivity contributes to obesity.

Data from the National Family Health Survey-3 suggest that 8.6% of children in urban areas and 12.9% in rural areas perform paid or unpaid work. This together with the fact that school enrollment rates are variable across India, suggests that physical activity needs to be assessed across multiple domains. Ecological data indicate that school based activity may be compromised by the absence by basic infrastructure; for instance, only 52.16% of all schools in 2005-6 had a playground (http://www.dise.in//downloads/Ar0506/Facility.pdf). Additionally, the gap between implementation of physical education against norms is high in Asia, although there are no specific data for India (Kinesiology; 2008; 40(1):5-28). A recent report on urban transport in India highlights the problems of walkability and road safety (Ministry of Urban Development, 2008); this has implications for understanding choices of transport to and from school and the potential for interventions in this area. At an individual level, published data suggest that sleep ≤ 8.5 hrs/day is associated with an increased odds of overweight of 6.8, while TV viewing > 45 min had a three fold increase in risk of overweight (Nutrition Journal 2007; 6: 25). Reduced participation in a variety of household and leisure related activities were all associated with increased overweight in 12-18 yr old adolescents (Obesity 2007; 15: 1384-1390).

## Research needs:

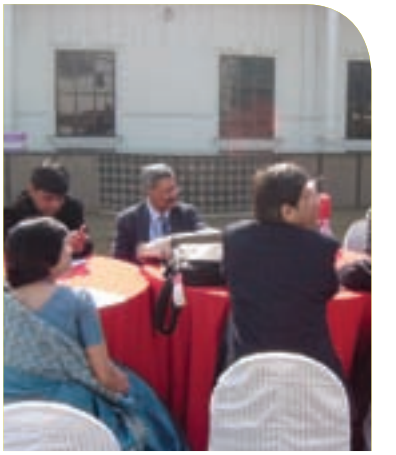
1. Develop and validate of objective physical activity assessment using current technology– current data in India are all reported; there considerable bias and error in this.
2. Evaluate the built environment and its impact on physical activity / obesity using GIS and spatial epidemiological techniques – this is a completely unexplored area in India in relation to children.
3. Enhance social science / qualitative research into understanding determinants / attitudes / barriers related to physical activity patterns – this is necessary to translate patterns of physical activity into possible interventions.
4. Evaluate Physical activity in all its dimensions across a continuum of change (rural – rural town – urban slum – urban middle class – recent migrant – 2nd generation migrants in Canada)
5. Evaluate the impact of physical activity interventions including yoga on the "Indian phenotype" and its functional consequences.

# **Session III :**
# The Obesogenic Environment during Childhood and Adolescence

## WORKING GROUP REPORTS

**3 Working Group - I**

# Over-nutrition, nutritional transition and the role of micronutrients



There is a huge gap in the knowledge on nutritional transition, its definitions, body size and composition, correlation to functionality and development stages of life cycle. In India nutritional data is collected periodically through the National Family Health Surveys, National Nutrition Monitoring Bureau and the National Sample Survey Organization, while in Canada there is CCHS and CHMS. There are consumer surveys undertaken in both countries.

## Recommendations:

1. Investigate the relationship of nutrition transition, development and undernutrition taking the varied progress within India and the higher end of development in Canada.
2. Interaction of body fat as protective/ predisposing to micronutrient deficiencies

**3. Working Group - II**

# Physical activity and the built environment

Physical activity can be done as free willing daily routine activity or as a structured activity through exercise regimes or sports. The importance of physical activity as a driver of the obesity transition needs to be studied throughout the spectrum of migration from less developed to more developed environments, as well as various stages of the life cycle. The built environment drives physical activity behavior at the population level. Physical activity as an intervention to prevent nutritional transition and to deal with obesity related co-morbidities needs better appreciation at individual, community and policy levels. Spatial epidemiology is a powerful tool to study the environment for physical activity along with other related behaviors.

## Recommendations:

1. Identify attitudes /barriers related to physical activity including issues related to Seasonality and Acceptance of physical activity interventions in various settings
2. Enhance capacities and tools for assessment of physical activity in epidemiological settings
3. Establish physical activity guidelines for Indian phenotype
4. Determine the extent and determinants of Non-Exercise Activity Thermogenesis (NEAT) in South Asians
5. Utilize Spatial Epidemiology to assess the built environment and its health impact

# **Session IV :**
# Interventions to Tackle the Obesity Epidemic

# Public health strategies to prevent obesity : school settings

**Stephen Manske**
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Public health focuses on populations, rather than individuals. Population level impact depends not just on effectiveness (i.e., extent of change on an individual) but also on reach (size of the population affected by an intervention). Policy makers choose public or population health interventions based on effectiveness and reach, but also cost. Therefore, an intervention that may not result in much individual change, but reaches a lot of people at a low cost could still have considerable impact.

Setting based interventions (e.g., schools) recognise the influence of environment on the health of the population. Ecological approaches underscore the interplay of environment with individual factors and the multiple influences on health outcomes. In school settings, Comprehensive School Health models (also referred to as Health Promoting or Healthy Schools) define four components as affecting student health: teaching and learning; healthy physical environment; supportive social environment and community partnerships. The last component points to the school as a focal point to engage the community and spread intervention, not just a place to "use" for interventions.

Several systematic reviews have examined the effectiveness of interventions for obesity prevention in the school setting. The website health-evidence.ca has rated the methodological strength of these reviews, and produced a summary. Highly rated reviews tend to conclude that we cannot draw strong conclusions as to the efficacy of school-based obesity prevention programs: too few published studies, existing studies have methodological concerns, including under-powered designs and there are no long-term sustained results (maintaining effect over years). It is apparent that any intervention will need to be tailored for different populations (e.g., gender, SES, cultural context).

## Research needs:

Research needs to benefit from natural experiments – learning as we go. The size of trials required to randomize state/provincial jurisdictions often makes them too costly to fund. Small controlled trials have generally not "scaled" well to population levels. Policy makers will move forward, with or without evidence. Researchers need to assist policy makers to learn from their experience. Several examples of such trials exist in Canada

1. What role can physical education classes and its specialists play in the overall activity levels of children and youth?
2. How do simple, yet novel approaches to increasing physical activity and healthy eating in schools work?
3. What value is there linking to Comprehensive School Health initiatives? Do inter-sectoral partnerships foster support for active living / healthy eating in schools?
4. How do we integrate implementation of policy (to create school environments that support healthy eating, physical activity and discourage sedentary behaviours)?
5. How do we adapt interventions to fit the local context?
6. How can we mobilize local resources to address obesity prevention?
7. How do we create capacity to learn from experience?

## Suggested reading:

1. Kropski, Keckley & Jensen (2008). School-based Obesity Prevention Programs: An Evidence-based Review, Obesity 16, 1009–1018
2. Stice et al (2006). A Meta-Analytic Review of Obesity Prevention Programs for Children and Adolescents: The Skinny on Interventions That Work. Psychological Bulletin,132, 5, 667–691

# Interventions to tackle the obesity epidemic at school level

**Nikhil Tandon**
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All India Institute of Medical Sciences
New Delhi

There is unequivocal evidence that school-based obesity prevention interventions are effective among children. A meta-analysis of school based intervention studies confirmed that interventions (diet & physical activity based) are successful (Katz et al. 2008). Schools are important avenues for health education, physical activity, diet based interventions and combinations thereof and often have links with stakeholders like parents, advocates, policymakers, organizations and other communities.

A health promoting school programme should; i). Enhance the health of the entire school community, ii). Address issues identified by all stake holders: students, teachers and parents, iii). Be action focused on the individual and the environment, and iv). Be a continuously evolving process. An example of a successful programme is CATCH (Child and Adolescent Trial for Cardiovascular Health) which was conducted in 4 states of the US. The intervention resulted in improved quality of school lunches (reduced fat content), increased moderate to vigorous physical activity in students and improved eating and physical activity behaviours. Similar programmes in Singapore (Toh et al, 2002) and Brazil (Matsudo et al, 2002) have also been successful in reducing obesity in school children. In India a programme called HRIDAY (Health Related Information Dissemination Amongst Youth) incorporated components like school based activities, debates, poster display, parent component (home team material) and ongoing training to successfully address the issue of tobacco use among adolescents.

## Research needs:

1. Assessment of critical causal factors and address intervention strategies according to local contexts
2. Methods / tools required to assess their impact
3. Need for different strategies for low and high income group schools

## Suggested reading:

1. Katz D. L., O'Connell M., Njike V. Y., et al., 2008, Strategies for the prevention and control of obesity in the school setting: systematic review and meta-analysis, Internal Journal of Obesity, 32(12), pp. 1780-1789.
2. Toh C. M., Cutter J., Chew S. K., 2002, School based intervention has reduced obesity in Singapore, British Medical Journal, 324, pp. 427-429

# Promoting healthy weights at the community level: Canadian perspectives

**Kim Raine**
Professor, Centre for Health Promotion Studies
School of Public Health, University of Alberta, Canada

According to the WHO (2000) Technical Report, Obesity: Preventing and Managing the Global Epidemic, "the fundamental causes of the obesity epidemic are societal, resulting from an environment that promotes sedentary lifestyles and the consumption of high fat, energy-dense diets." Increasingly, research is providing evidence to support the connection between environment and behaviours promoting obesity, such as diet, physical inactivity and sedentary behaviour. If the environment is the context for behaviours, then there is promise in addressing obesity through community as a point of access to environmental change for promoting healthy weights.

Using an ecological approach to changing environments as a conceptual framework, the Healthy Alberta Communities Project is working in 4 diverse communities to develop models for effective community participation in the identification of priority areas of intervention unique to each community context. The ANGELO Framework (Swinburn, Egger & Raza, 1999) is used to identify needed changes in the community environments by organizing interventions according to the following types of environments addressed: physical, economic, socio-cultural and political. Some interventions underway include connecting trail systems for active transportation, a social enterprise for food security, Farmers' Market revitalization, and healthy restaurant choices. Community partnerships can develop into self-sustaining projects that influence a relatively small number of citizens (e.g. community gardens) and broad-level policy action that influence entire communities (e.g. active transportation in urban planning). In addition to a pre-post assessment of community health status, including obesity rates, we are employing novel community evaluation to advance important understandings of how communities change and how transforming environments influences health.

## Research Needs:

Canadian-Indian comparisons of community-based interventions for obesity prevention to;

a) advance theoretical understanding of social change,

b) advance and share methodological strategies and

c) explore how community action influences policy change.

## Suggested Reading:

1. Raine, K., Spence, J. C., Church, J., Boulé, N., Slater, L., Marko, J., Gibbons, K. and Hemphill, E. (2008) State of the Evidence Review on Urban Health and Healthy Weights (Ottawa: CIHI). http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=GR_1929_E

2. Raine, K., & Wilson, E. Obesity Prevention in the Canadian Population: Policy Recommendations for Environmental Change. 2006 Canadian Clinical Practice Guidelines on the Management and Prevention of Obesity in Adults and Children. Canadian Medical Association Journal. 176 (8 Suppl):106-110, 2007.

# Community based intervention for tackling obesity

**D. Prabhakaran**
Executive Director,
Centre for Chronic Disease Control
New Delhi

Childhood obesity and other early life determinants play a major role in predicting adult chronic disease. There are several approaches to prevention of chronic diseases through the community; health education and media campaigns, health service intervention, community organization and mobilization. Other approaches where targeting community may play a role including policy formulation and prevention among high risk individuals. The role of conventional approaches such as health education and medical campaign were discussed in more details.

Very few studies have targeted obesity as an out come in children. Demattia et. al in their review of 12 studies involving 6 community and 6 clinic based publication observed that there were no real community based studies, but all were school based intervention. Most of these showed a modest reduction in weight. Among adults, we identified 6 community based intervention targeting obesity as an outcome. These include the Stanford three community study, Stanford five city study, Minnesota Heart Health programme, Parvticket Heart Health Program, the North Karelia project and a study from Mauritius. Among these studies despite positive risk factor changes, there was no evidence of obesity reduction in 4 of the 6 studies. Based on their review of several community based prevention studies Ebrahim et. al concluded that the community based studies had limited utility in the general population as the pooled effects of population based multiple risk factor intervention on mortality were insignificant and small. However, they did not rule out potentially important up to 10% reduction in mortality that could have been missed due to the low power and shorten duration of follow up. With this background we designed and implemented a comprehensive risk reduction programme in 6 industrial sites across India and compared the results against a single industrial site without any intervention, and a substantial reduction in cardiovascular disease risk factors was noted over a 5 year period. This model can be modified and adapted for children (at least among the urban upper and middle classes of India).

While planning a community based programme, the following issues need to be taken into consideration: a). The extent of community outreach and ensuring community participation, b). The expected magnitude of benefit and c). Inclusion of a policy component in the programme. In addition the focus should be multiple risk factor targets with the family/group as a unit rather than individuals.

## Research Needs:

i What should be the design (Cluster randomization vs Individual randomization) and analytical framework of community studies :

ii How should outcomes assessment done: Process vs quantifiable end point

iii What is the cost effectiveness?

iv What should be valid and reliable measures of physical activity and dietary changes in children

v What are the socio cultural factors that influence the programme

vi How do we position such programmes within existing health system?

# Interventions to tackle obesity at the societal level: A brain-to-society approach to the promotion of healthy eating

**Laurette Dubé**
James McGill Chair, Consumer and Lifestyle Psychology and Marketing,Full Professor, Desautels Faculty of Management (Marketing), McGill University, Montreal, Canada

Prior work on childhood obesity have either focused on individual or societal interventions, without taking into consideration that biology and environment are part of the same system guiding individual behavior. Domains where choice is partly conditioned by biology and environment include among others, diet, exercise and sedentary behavior; sleep, stress, and other facets of the work/leisure/play balance. A novel Brain-to-Society model of individual and societal choice was presented in the context of eating, with preliminary results.

The "brain-to-society systems" choice model is a broad integrative approach developed to form a solid theoretical bridge between what is known about brain function (dopamine pathways and executive control) and environmental influences upon individual choice. The models articulates a set of complex and dynamic relationships between biology, behavior, and environment affecting choice at the individual-level, which in turn inform choices made at the societal level. Models using agent-based complex systems may further provide a principled way to relate individual choice, decisions made by businesses and social organizations, as well as policy instruments considered by governments. Preliminary results of a field study were presented. The study involve a sample of 415 adults with individual-level measures including (i) personal predispositions related to dopaminergic system (behavioral approach tendency; BAS), to executive control function (restraint), and to overall success in control over one's life (mastery). Sociodemographic, behavioural, anthropometric, biological and social network data were also collected. A geographic information system or GIS (MEGAPHONE) containing a comprehensive variety of area-level measures was used to contribute contextual data to the study. Generalization of these results for children population and future research on individual and societal interventions to promote healthy lifestyle was discussed.

## Research Needs:

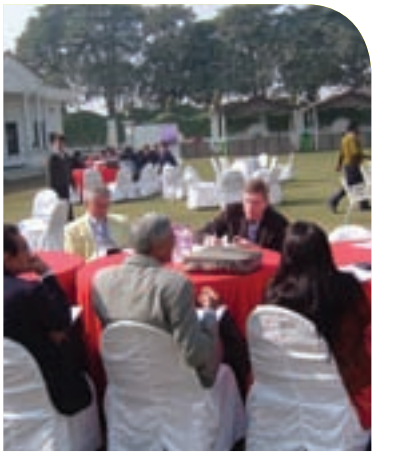
Study the genetic, epigenetic, neural and psychological processes operating at the individual level in the broader context of decisions made by social and economic actors at all levels in society.

# **Session IV :**
# Interventions to Tackle the Obesity Epidemic

## WORKING GROUP REPORTS

**4. Working Group - I**

# Behavioral and Social Strategies



Interventions for prevention and control of obesity require strong behavioral and social strategies at individual, family, community, system and policy levels.

## Recommendations:

1. Study the perceptions of risk of Noncommunicable diseases in relation to actual health risk and determining and intervening on multi-level, multi-sector drivers of social norms which position risk distributions
2. Social modeling of positive parental health practices to which children are exposed. Includes determinants of health literacy (reading ability, health knowledge, attitudes, values and beliefs) and multi-level strategies to improve health literacy in parents and children
3. Evaluation of “food-scapes” and “activity-scapes” around schools and homes, and actual behaviours within these areas, in relation to childrens’ BMIs
4. Evaluating the effectiveness of government and institutional strategies to reduce social inequity related to the double burden of Noncommunicable diseases

**4. Working Group - II**

# Public health strategies

These strategies include those described under individual sections. The focus is to understand, assess, innovate, implement, monitor and evaluate all research programs directed at improving population level health indicators. It synergies with other health promoting activities.

## Recommendations:

1. Determine what are acceptable public health interventions for different groups (opinion).
2. Devise or adapt peer led teaching for obesity prevention
3. Assess role and impact of media and advocacy on inducing obesity-related behaviours, to promote awareness in specific groups (e.g., politicians).
4. Create a business model for policy changes.

a. Assess economic & health impact of the obesity epidemic. Report above in a way that moves evidence to action

5. Identify barriers creating obesogenic environment (including policy)
6. Assess political and policy interventions

– Assess food industry legislation (e.g. food labels, trans fats)
– Cluster randomized trials of impact of changing tax (e.g. reduced cost for active transport, healthy foods)
– Mandate healthy school meals and evaluate its impact.
– Subsidize businesses that “create health”.
– Employ research to action methodologies to create & assess policies.

7. Advocate for mandated & marked Physical Education in all grades in schools.
8. Compare across jurisdictions with different policies / approaches / incentives, International and / or cross-state within countries
9. Establish Multi-level systems approaches – quantitative modeling
10. Assess evidence of interventions that specifically reduce Indo phenotype of truncal obesity (e.g., Yoga)

a. Assess feasibility of yoga implementation for Canadian population.

11. Identify and promote traditionally acceptable foods.

# SUMMARY & RECOMMENDATIONS

# SUMMARY

The ICMR-CIHR workshop on Childhood Obesity and Noncommunicable diseases held on 14-16th January 2009 in Delhi, India was the first initiative under the MoU of ICMR and CIHR, and addressed an agreed on area of interest- childhood obesity. The program of the workshop was developed to address the causes and prevention of childhood obesity. Experts from both countries discussed the agenda through working groups for each session: Epidemiologic transition & its consequences, early origins of obesity, the obesogenic environment during childhood and adolescence, public health interventions to tackle the obesity epidemic.

The outcome of each session was to identify research questions/areas wherein investigators from both countries could work together. The collaboration is open to any investigator from both countries, not limited to the participants. The ICMR and CHIR will facilitate and coordinate the proposals and investigators from the respective countries.

This report is intended to serve as resource for those investigators who desire to collaborate with their counterparts in either countries. The outcome was to promote collaboration between the scientists from India and Canada through the following Mechanisms:

1. Identification of research areas which can be done in both countries
2. Sharing of information, knowledge, expertise and resources
3. The outcomes should be applicable not only to national needs but also be meaningful for a wider, international audience.

Based on research needs identified by the key speakers in each session and the outcomes of the working group discussions, the following areas were identified for potential collaboration:

## The collaboration should foster:

1. Sharing of methods, tools and research materials
2. Building investigator capacity in both countries
3. Exchange of scientists and students

Though the workshop addressed childhood obesity, but it was agreed that research proposals will include the all dimensions so that a holistic view is kept in mind. This will also allow aligning the research activities with other programs in both countries.

# RECOMMENDATIONS

Based on the discussions held during the workshop, the following areas of research collaboration were identified.

1. **Surveillance of overweight, obesity and the transition from undernutrition to overnuturition, and their related health outcomes**
   - It will include the transition from underweight to overweight and obesity, measurements, its determinants (social, economic, environmental, policy etc), ethnic heterogeneity, migration from rural to urban areas and outside countries, its health consequences, double burden of disease.
   - Assessment of growth parameters, trajectories and monitoring

2. **The early origins of obesity, including maternal attributes, prenatal influences, infant feeding and nutrition, genetics, epigenetics and animal model studies**
   - Assessment of nutrition during these periods of development
   - Use of animal models to understand pathogenesis, growth and development and interventions
   - Utilizing basic science tools and expertise
   - Translation of basic research to clinical and public health use

3. **The obesogenic environment and its drivers**
   - Overnuturition, nutrition transition and role of micronutrients
   - Physical inactivity and the built environment
   - Policy influences

4. **Behavioral, social and public health approaches for obesity prevention and control**
   - Working at school, community and societal levels
   - Advocacy
   - Inter-sectoral collaboration

Further details within each area have been presented in the concerned section.

## ANNEXURES :

a) List of Participants

b) Agenda of Workshop

# LIST OF PARTICIPANTS

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## ICMR-CIHR Workshop

"Childhood Obesity and Noncommunicable Diseases"

14-16, January 2009

## AGENDA

### Workshop Coordinators

Indian Council of Medical Research (ICMR)

**Bela Shah**
Head, Division of Noncommunicable Diseases

**Prashant Mathur**
Scientist 'D', Division of Noncommunicable Diseases

**Canadian Institutes of Health Research (CIHR)**
(Institute of Human Development, Child and Youth Health)

**Michael Kramer**
Scientific Director, IHDCYH

**Anne- Cécile Desfaits**
Assistant Director, IHDCYH

## Inaugural Function (14th January 2009)

**Venue: Wet 'n' Wild Resort**
**Time: 5.00- 6.30 pm**

- **Welcome and Overview of Workshop :**
  - Bela Shah, Head, Division of NCD, ICMR
- **Perspectives on the Indo-Canadian Collaboration :**
  - Michael Kramer, Scientific Director, IHDCYH, CIHR
  - Lalit Kant, Head, Division of IHD, ICMR
- **Inaugural Address**
  - VM Katoch, Director General, ICMR & Secretary, Department of Health Research
- **Keynote addresses**

  **Fundamental drivers of optimal weight, shape and health: A Noncommunicable Diseases perspective**
  - Laurette Dubé, Professor, McGill University
  - NK Arora, Executive Director, INCLEN
- **Vote of thanks:**
  - Prashant Mathur, Scientist D, Division of NCD, ICMR

6.30-8.30pm Dinner hosted by Director General, ICMR & Secretary, Department of Health Research, Govt. of India

(All Participants of the workshop are cordially invited)

## 14th January 2009 (Day 1)

09.30 am Registration of participants & refreshments

10.00 am Welcome by the Workshop Coordinators
- o Bela Shah
- o Michael Kramer

- **Round of Introduction of Participants**

10.30 am Session I: Epidemiologic Transition & its Consequences

Chairs : Mark Daniel HPS Sachdeva

**Introductory talk (15 mins each)**

I. Canadian perspective:
**Social and environmental determinants:** Mark Daniel
**Ethnic heterogeneity:** Scott Lear

II. Indian Perspective
**Epidemiological transition:** Prashant Mathur
**Cardiometabolic consequences of the epidemiolog cal transition:** Anoop Misra

**Concurrent Working Groups**

A. Surveillance of obesity and its determinants in children and adolescents
Moderators: Steve Manske Anupa Siddhu

B. Double burden and its relevance to developing economies
Moderators : Scott Lear A Laxmaiah

**12.30pm Lunch break**

1.30 pm Session II: Early Origins of Obesity
Chairs: Jean-Pierre Chanonine D Prabhakaran

**Introductory talks (15 mins each)**

A. Fetal origins of the obesity epidemic
KS Joseph, CS Yajnik
B. Role of Infant feeding in the obesity epidemic
Michael Kramer, HPS Sachdeva
C. Animal models to understand the obesity epidemic:
Jean-Pierre Chanonine, M Raghunath

**3.00pm Refreshments**

3.30- 4.30pm Concurrent Working Groups

A. Fetal and infant origins of obesity
Moderators: KS Joseph Anoop Misra

**15th January 2009 (Day 2)**

10.00 am Report of Chairs for Session I & II working groups (10 mins each) and Discussions

10.30am Session III: The Obesogenic Environment During Childhood and Adolescence

Chairs : Scott Lear Nikhil Tandon

**Introductory talks (15 mins each)**

A. The Nutrition transition: Kim Raine, Umesh Kapil

B. Physical inactivity as a driver of obesity: John Spence, Mario Vaz

11.30 am Refreshments

12.00pm Concurrent Working Groups

A. Over-nutrition, nutritional transition and the role of micronutrients
Moderators: Kim Raine CS Yajnik

B. Physical activity and the built environment
Moderators: John Spence Mario Vaz

**1.30pm Lunch break**

2.30pm Session IV: Interventions to Tackle the Obesity Epidemic

Chairs: John Spence NK Arora

**Introductory talks (15 mins each)**

A. At school level: Steve Manske, Nikhil Tandon
B. At community level: Kim Raine, D Prabhakaran
C. At societal level: Laurette Dubé

**4.00 pm Refreshment break**

**4.30- 5.30pm Concurrent Working Groups**

A. Behavioral and Social strategies
Moderators: Mark Daniel Arnab Ghosh

B. Public health strategies
Moderators: Steve Manske Umesh Kapil

**6.00 – 8.30pm Dinner hosted by CIHR**

(All Participants of the workshop are cordially invited)

**16th January 2009 (Day 3)**

9.30am ICMR-CIHR official's in-house meeting

9.30am Open interactive session of participants for collaboration (parallel session)
Chairs: Laurette Dubé NK Arora

10.30am Report of Chairs of Session III and IV working groups (10 mins each) and Discussions

**11.00am Refreshments**

11.30am Session V: Impetus for Developing a Research Program on Childhood Obesity

Chairs: Michael Kramer Bela Shah

**Introductory Talks (10 mins each)**

A. Canadian perspective: Michael Kramer
B. Indian perspective: Lalit Kant

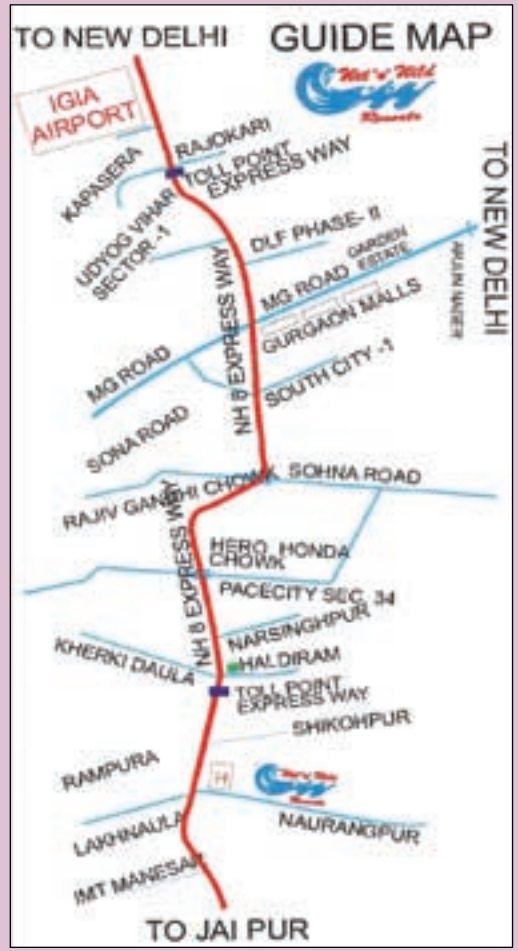
Discussions on developing a collaborative program on Childhood Obesity research (open discussion)

- Identification of potential areas of collaboration
- Common ground: areas of mutual strength
- Complementary expertise
- Need for capacity building
- Type(s) of grants to be offered

**1.00pm Closing of workshop**

**1.30pm Lunch and Farewell!!**

**Venue: Wet 'n' Wild Resort**




Distance from IGI Airport: 26 Kms
Distance from New Delhi: 41 Kms

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# ORGANIZING COMMITTEE AT ICMR, NEW DELHI

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Dr SK Bhattacharya, Additional Director General, ICMR

### Workshop Coordinators, Division of Noncommunicable Diseases

Dr Bela Shah
Dr Prashant Mathur

### International Health Division, ICMR

Dr Lalit Kant
Dr Mukesh Kumar

### Administrative Support

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Mr PK Chawla
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Ms Madhu Narula
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