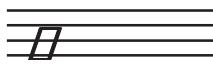

It's the time to



family reunion at MAHABALESHWAR Jan. 2005

We had our first official 'workshop' at **Khandala** in September 1994. The backdrop of the gushing waterfalls & green hills was stunning. **David Barker's** new theories were equally fascinating. Each year since then, we have met at various locales with equally memorable meetings and we all look forward to the annual reunion with the same fervor & excitement. We have really grown as a 'scientific family' — new names have been added (**FOAD, DOHaD — SNEHA**); we

have had two World Congresses & a third is scheduled later this year.

This year we meet at Mahabaleshwar, the quiet & sleepy (?) resort near Pune. At this time of the year it should be full of pretty sights and bright flowers & — to welcome our English friends, (& to make them feel at home), there may be some snow!

As always, the backbone of the meeting has been **Caroline Fall**, who has worked long distance & for long hours putting the Scientific Programme & Abstract Booklet together. She is also the 'Advisor in Chief' for the local organizing committee.

Source : The Indian Express, Dated: 13th Jan. 2005

This year we've received a record number also have a record number of presentations by which shows the growing enthusiasm in this field

It is really unfortunate that David Barker is 'Godfather'! But he has to be excused, as he is resources for more studies & — more meetings!

HAPPY NEW YEAR and Happy conference

On behalf of the local organizing committee, I e



Sheila Bhawe

**Anand Pandit, Ashish Bavdekar, Premalatha Raman, Mahendra Hoge
Priyadarshini Muley-Lotankar, Deepak Mundle,**

11th Annual Sneha-MRC International Workshop

**Developmental Origins of
Health and Adult Disease**

(DOHaD)

Sherwood Hotel
MAHABALESHWAR
Maharashtra
India

January 20th-23rd 2005

SCIENTIFIC PROGRAMME

11.30-11.45 **Introduction to the meeting**
Sheila Bhawe, Anand Pandit and Caroline Fall

SESSION 1 Friday 21st January 11.30 am to 13.30 pm

Theme: MICRONUTRIENTS

Chairman: Chittaranjan Yajnik

Each paper 10 minutes speaking time followed by 5 minutes discussion

11.45-12.00 **Vitamin B12 and folate status in rural Indian pregnant women and neonatal size; Pune Maternal Nutrition Study**
Swapna Deshpande

12.00-12.15 **Maternal folic acid supplementation alters brain n-3 fatty acid levels in Wistar rats**
Sadhana Joshi

12.15-12.30 **Vitamin B12 supplementation reduces plasma total homocysteine concentration in Indian non-pregnant women**
Hemangi Lubree

12.30-12.45 **Discussion**

12.45-13.00 **Effects of the Mumbai Maternal Nutrition Study supplements and spirulina on full blood count and anthropometry in non-pregnant women**
Priyadarshini Lotankar

13.00-13.15 **Health and Human capacity; addressing scientific and socio-economic challenges in India**
Mekhala Krishnamurthy

13.15-13.30 **Discussion**

LUNCH

SESSION 2 Friday 21st January 14.30 pm to 16.30 pm

Theme: NUTRITION IN PREGNANCY

Chairman: Shobha Rao

- 14.30-14.45** **Prevalence of Multiple Micronutrient Deficiencies amongst Pregnant Women in a Rural Block of Haryana State, India**
Umesh Kapil
- 14.45-15.00** **Haemoglobin concentration in pregnancy and its influence on size at birth**
Suhas Otiv
- 15.00-15.15** **Community-based intervention to improve pregnancy outcome in Nepal**
Anthony Costello/David Osrin
- 15.15-15.45** **The Mumbai Maternal Nutrition Project**
Ramesh Potdar, Mira Gandhi, Vijaya Taskar, G Subbulakshmi
- 15.45-16.15** **Results of a micronutrient supplementation trial among pregnant women in Nepal**
David Osrin
- 16.15-16.30** **Discussion**

Evening social programme:

Shopping in Mahabaleshwar bazaar, followed by Thali dinner (venue to be announced)

SESSION 3 Saturday 22nd January 09.00 am to 13.45 pm

Theme: FACTORS IN EARLY LIFE AND LATER DISEASE

Chairman: Santosh Bhargava

Each paper 10 minutes speaking time followed by 5 minutes discussion

- 09.00-09.15** Newborn size, infant and childhood growth, and body composition and cardiovascular risk factors at 6 years; the Pune Maternal Nutrition Study
Charu Joglekar
- 09.15-09.30** Principal Component Analysis of maternal diet during gestation to predict 6-year outcomes in the child; the Pune Maternal Nutrition Study
David Fisher
- 09.30-09.45** Effects of maternal and paternal birthsize on offspring cardiovascular disease risk; an intergenerational study in South Indian adults
SR Veena
- 09.45-10.00** The Metabolic syndrome and associated lifestyle factors among young Indian adults
B Antonisamy
- 10.00-10.15** Discussion
- 10.15-10.30** Determinants of maternal hyperglycaemia 6 years after delivery
Niranjan Joshi
- 10.30-10.45** Growth and body composition, and glucose/insulin metabolism in Indian children – relationships to maternal gestational diabetes; Parthenon follow-up study
GV Krishnaveni
- 10.45-11.00** Childhood obesity in offspring of maternal diabetes: studies in the normal population suggest maternal obesity not maternal glycaemia determines early childhood BMI
Andrew Hattersley
- 11.00-11.15** Discussion
- 11.15-11.30** COFFEE

SESSION 4 Sunday 23rd January 08.30 am to 10.30 am

Theme: BODY COMPOSITION, OBESITY AND PHYSICAL ACTIVITY

Chairman: HPS Sachdev

Each paper 10 minutes speaking time followed by 5 minutes discussion

- 08.30-08.45** **Comparison of physical activity scores with physical activity recorded by accelerometer; problems and pitfalls faced in a pilot study**
G Priya
- 08.45-09.00** **Physical activity assessment in adults and children**
Inga Mills
- 09.00-09.15** **Food intake and Physical Activity in Pune Urban Children Cohort Study**
Vaishali Madkaikar
- 09.15-09.30** **Prevention of obesity in Indian schoolchildren; a proposed lifestyle programme in Symbiosis school, Pune**
Rajiv Yeravdekar
- 09.30-09.45** **Increasing non-communicable disease prevalence in young rural adults**
Asawari Kanade
- 09.45-10.00** **Body composition and hyperglycaemia in middle-aged Indian men**
Anjali Ganpule
- 10.00-10.30** **Final discussion**

END OF SCIENTIFIC MEETING

11.30 BRUNCH

DELEGATES DEPART

POSTERS

- 1. A study of multivitamin prescription practice in early pregnancy**
S Ambardekar
- 2. Prevalence of obesity among adolescent boys from urban affluent population in Pune**
AN Kanade, P Apte, M Deshpande, R Kelkar, S Rao
- 3. Transcutaneous absorption of topically massaged oil in neonates**
Ashish Bavdekar
- 4. Fast versus slow enteral feeding in babies less than 1.5 kg body weight with special reference to their early outcome**
Tapabrata Chatterjee
- 5. Non-invasive evaluation of endothelial function and arterial mechanism in children of hypertensive parents**
Anita Khalil
- 6. Parental role in the prevention of adolescent obesity**
S Rao, T Mashelkar, P Apte, AN Kanade
- 7. Obesity and non-communicable disease risks in urban affluent population**
Kanade AN, Gokhale MK, Parab PS, Kelkar RS, Rao S
- 8. Clustering of non-communicable disease risk variables among young rural Indian population**
S Rao, AN Kanade, KP Patil, SA Deshpande
- 9. Coronary heart disease and glucose intolerance in the first Mysore cohort restudied after 10 years**
SR Veena

Chairman: Anand Pandit

Each paper 10 minutes speaking time followed by 5 minutes discussion

- 11.30-11.45 Update on follow-up of the New Delhi birth cohort**
Santosh Bhargava and HPS Sachdev
- 11.45-12.00 Early life undernutrition, postnatal growth and risk of non-communicable diseases in young adults from rural India**
Shobha Rao
- 12.00-12.15 Does supplemental nutrition in early life reduce later risk of cardiovascular disease?**
Sanjay Kinra
- 12.15-12.30 Insulin resistance syndrome in Indian children; continued studies of the Pune urban cohort**
Madhumati Otiv
- 12.30-12.45 Ayurvedic body proportion and its association with modern parameters of adiposity and diabetes**
Jyoti Shirodkar
- 12.45-13.00 Discussion**
- 13.00-13.30 Mendelian randomisation; prospects and limitations**
Shah Ebrahim
- 13.30-13.45 Discussion**
- 13.45 GROUP PHOTOGRAPH**

LUNCH

FOR SNEHA MEMBERS ONLY:
ANNUAL GENERAL MEETING (served with lunch)

Afternoon social programme:
Sightseeing in and around Mahabaleshwar

Evening social programme:
MAGIC SHOW AND BARBECUE DINNER

VITAMIN B12 AND FOLATE STATUS IN RURAL INDIAN PREGNANT WOMEN AND NEONATAL SIZE : PUNE MATERNAL NUTRITION STUDY

*Swapna Deshpande and the Pune Maternal Nutrition Study investigators
Diabetes unit, KEM Hospital, Pune*

Background: Indians have widespread vitamin B12 deficiency. Vitamin B12 and folate influence fetal growth and may contribute to intra-uterine programming of cardiovascular risk factors.

Objective: To study vitamin B12 and folate status in Indian pregnant women, and its effect on offspring size at birth and insulin resistance at 6 years of age.

Design: We measured maternal plasma vitamin B12, homocysteine (tHcy), methyl malonic acid (MMA) and red cell folate concentrations on frozen samples collected in 700 pregnant rural women at 28±2 wk gestation in the Pune Maternal Nutrition Study (PMNS). The PMNS database has information on maternal nutrition, pregnancy outcome and offspring size at birth. Offspring were studied at 6y of age for cardiovascular risk factors.

Results: Four hundred sixty six women (72%) had low vitamin B12 status (plasma vitamin B12 <150 pmol/l), 581 (90%) had high MMA levels and only one woman had low RCF. Median plasma tHcy was 8.6 (IQR, 6.7, 10.8) µmol/L, and MMA 0.7 (IQR, 0.4, 1.2) both were related to vitamin B12 and folate status. Maternal vit B12 status was predicted by non-vegetarian food and milk intake (adjusting for age,

SES, macronutrient intake, and gestation). There was no significant dietary predictor of RCF and MMA concentrations. Lower plasma vitamin B12 concentrations but not RCF was related to maternal insulin resistance.

Neonatal size (except length and adiposity) was predicted by maternal RCF concentrations but not by plasma vitamin B12 concentrations (adjusted for maternal age, gestation and offspring gender). Mothers who had high RCF and low vitamin B12 status gave birth to larger birthweight babies. Higher maternal plasma tHcy concentrations predicted SGA and LBW babies (9.03 vs 8.5, p<0.05).

High maternal RCF at 28 wk gestation was a significant predictor of HOMA insulin resistance in the offspring at 6y of age; this effect was exaggerated by low vitamin B12 status in the mother

Conclusion: Ours is the first demonstration of the association between maternal circulating nutrients and offspring CV risk in childhood. Higher folate status in mother predicted higher CV risk in the offspring, probably because of the associated vitamin B12 deficiency. This could operate through epigenetic mechanisms.



MATERNAL FOLIC ACID SUPPLEMENTATION ALTERS BRAIN N-3 FATTY ACID LEVELS IN WISTAR RATS

Sadhana Joshi, Shobha Rao, Anvita Kale, Mahabaleshwar Hegde & Sahebarao Mahadik**
Interactive Research School for Health Affairs, Bharati Vidyapeeth, Pune 411043, India Dept.
of Biometry and Nutrition Unit, *Agharkar Research Institute, G.G. Agarkar Road, Pune
411004, India ** Dept of psychiatry, Medical college of Georgia, Augusta, USA*

The role of folic acid in fetal adaptation is well documented. Folic acid and LC PUFA have independent effects on fetal growth. However folic acid may also modify LC PUFA metabolism. Omega three fatty acids are known to be critical in early brain development. Recent research has postulated that the prevalence of a number of adult non-communicable diseases like diabetes may be due to a defect in the insulin receptors in the brain. In view of the fact that folic acid can modify LC PUFA metabolism it is necessary to investigate whether folate supplementation during gestation which is popular in many developing countries has any impact on brain fatty acid levels. Additionally it is well known that environmental exposures in prenatal life may imprint the HPA axis resulting in permanent modifications of the neuro-endocrine responses to stress. The present study, therefore, examines the effect of folic acid supplementation at marginal level of protein during pregnancy, on the brain fatty acid profile and on corticosterone concentrations in the Wistar rat offspring at 11 mo of age. Pregnant female rats from 4 groups (6 in each) were fed casein diets either with 18g protein / 100g diet (control diet), 12g protein / 100g diet supplemented with 8mg folic acid (FAS), 12 g protein / 100 g diet without folic acid (FAD) or 12 g protein / 100 g diet (MP) with 2 mg folic acid to observe the effects of folate

supplementation at marginal protein level. Pups were weaned to a standard laboratory diet with 18 g protein/100 g diet. Folate supplementation supported fetal growth as well as postnatal growth. However, at 11 mo of age all male rats in the FAS group showed lower docosahexaenoic acid ($p < 0.05$) as compared to control rats (6.04 ± 2.28 Vs 10.33 ± 0.86 g/100 fatty acids) and higher n6/n3 ratio ($p < 0.05$) indicating that the ratio of membrane omega-3 to omega-6 PUFA can be modulated by dietary treatment. Plasma corticosterone concentrations were higher ($p < 0.05$) in male rats from FAS group compared with control rats. This is probably an indication of metabolic stress as a result of achieving growth comparable with those in control group on marginal protein level. Serum folate and vitamin B12 concentrations in the offspring were not affected by the treatments. Results suggest that maternal folic acid supplementation may regulate brain n-3 fatty acid metabolism. There is a need for further studies on the expression of desaturases or antioxidant enzymes during maternal folate supplementation. The present study indicated that current levels of folic acid supplementation used in interventions during pregnancy are perhaps able to yield only short term benefits of improving birth weights and are not supportive of long term benefits.



VITAMIN B12 SUPPLEMENTATION REDUCES PLASMA TOTAL HOMOCYSTEINE CONCENTRATION IN INDIAN NON-PREGNANT WOMEN

Lubree HG

Diabetes Unit, KEM Hospital, Pune

Background: Vitamin B12 deficiency is common in India. This may have effect on fetal growth and its risk of future cardiovascular disease (programming). There is little information on effect of vitamin B12 supplementation on plasma total homocysteine (tHcy) levels in Indians.

Objectives: To study the effect of vitamin B12 supplementation on tHcy concentration in Indian women

Methods: This was a proof of principle trial with a randomised control, 2×2 factorial design (B12 and GLV, GLV only, B12 only, and placebo). We supplemented with 500µg of vitamin B12 and 100g of cooked GLV or placebo 3 times a week for 6 weeks to 40 non-pregnant, vegetarian women aged 20-50y. Randomisation was stratified by age and vitamin B12 status.

Results: At baseline, 26/40 (65%) of women were vitamin B12 deficient (<150 pmol/L). Plasma folate concentration was low (<3 ng/ml) in 10 (25%) women and 24 (60%) women

had hyperhomocysteinemia ($\geq 15\mu\text{mol/L}$). Vitamin B12 supplementation increased plasma vitamin B12 concentration (125 to 215 pmol/l, $p<0.001$). The rise in plasma vitamin B12 concentration was similar (~ 60%) whether they ate GLV or placebo vegetables. After 2 weeks (6 tablets of 500 µg methylcobalamin) plasma tHcy concentration fell by an average 28 %, from 18.4 to 13.3 µmol/L and the number of women with hyperhomocysteinemia fell from 11 to 7. Fall in tHcy was proportional to the initial level of plasma tHcy ($r=-0.5$, $p<0.000$) and vitamin B12 ($r=-0.77$, $p<0.000$). Supplementation of vitamin B12 or GLV failed to change blood hemoglobin concentration, MCV or vibration sensory threshold.

Summary: B12 supplementation reduced tHcy concentrations by one third in non-pregnant women within 2 weeks. There was no further effect after 6 weeks. GLV consumption did not increase plasma folate or reduce tHcy concentration. Our results stress that vitamin B12 may be the most effective treatment for hyperhomocysteinemia in Indians.



EFFECT OF THE MUMBAI MATERNAL NUTRITION PROJECT (MMNP) SUPPLEMENTS AND 'SPIRULINA CHIKKI' ON BLOOD COUNT, MICRO-NUTRIENT STATUS AND ANTHROPOMETRY IN NON-PREGNANT WOMEN

Priyadarshini Lotankar, Lesley McDowell, Devi Shivshankaran, G Subbulakshmi, Ramesh Potdar, Caroline Fall

Aim: To test the hypothesis that the MMNP test supplement and 'spirulina chikki' increase blood micronutrient levels when taken daily for up to three months.

Methods: 90 women of reproductive age were recruited from slum communities within the WIN-CSSC catchment area (Ambedkar Nagar and Maharashtra Nagar). The sample included Muslims and Hindus, both of whom were mainly non-vegetarian. At baseline, anthropometry was carried out, an FFQ and infection questionnaire was administered, and a blood sample was taken for full blood count, plasma retinol, vitamins B2, B12 and C, folic acid and ferritin (completed for 77 women). The women were randomised into three groups, stratified by age and BMI: Group A: MMNP control supplement (a potato/onion snack, n=28), Group B: MMNP test supplement (a snack with added green leafy vegetables ~100g, fruit ~200g and milk ~70g in dried powder form, n=24) and Group C: Chikki with added spirulina powder 4g, n=23). Supplements B and C are rich in beta-carotene, vitamin B2 and folate, while supplement B is also rich in iron and supplement C is rich in vitamin B12. Supplementation took place 6 days per week and health workers were instructed to observe the women while they ate the supplement. This presentation describes data collected 20 days into the study, when 51 women agreed to have

repeat blood samples (A n=16, B n=14 and C n=21). The study will be completed at the end of January 2005, when the baseline investigations will be repeated.

Results: The study was complicated by the occurrence of Shravan and Ganapati immediately before, and Navratri, Dussera and Ramadan during the supplement period. The MMNP test supplement (Group B) was the least popular; 8/24 (33%) women dropped out of the study, compared with 6/28 (21%) in group A and 2/23 (9%) in group C. Several women, in all three supplement groups, described increased wellbeing, suggesting some placebo effect. The mean age and BMI of the women were 30 years and 21.4kg/m². Micronutrient analyses are not yet available. The women's age, haemoglobin, white blood cell count, red cell indices and anthropometric measurements were similar in the three groups at baseline. Mean haemoglobin concentrations were low (11.0g/dl (SD 1.17)). After 20 days supplementation, haemoglobin concentrations had risen in all groups, and were highest in Group A (A: +0.92:11.92g/dl; B: +0.30:11.19g/dl; C: +0.47:11.63g/dl; ANOVA for differences between groups for pre- v post-haemoglobin p=0.01). There were no statistically significant differences between the groups in any of the other parameters; however BMI increased in Group C by 0.26 units (A: -0.12: 20.6kg/m², B: -0.11: 21.7kg/m², C: +0.26:

21.6kg/m²; ANOVA p=0.1). There was no accompanying increase in body fat (skinfold measurements) in this group.

Conclusions: There was no apparent benefit on blood count indices after 20 days of micronutrient-rich food supplements compared with a control. Possible reasons could include: 1) insufficient time for the supplements to have an effect, 2) lack of bio-availability of the

nutrients, 3) reduction in the women's habitual food and nutrient intake. The latter will be assessed by FFQ and 24-hour recall data (data not yet analysed). A further possibility is that the supplements (especially B) were not fully consumed – this supplement needs further work to improve its palatability. Supplement C may be associated with an increase in BMI. The investigations will be repeated after 3 month's supplementation (end of January 2005).



HEALTH AND HUMAN CAPACITY: ADDRESSING SCIENTIFIC AND SOCIOECONOMIC CHALLENGES IN INDIA

Krishnamurthy M, Jha V
ICICI Social Initiatives Group, Mumbai

Health is a fundamental capacity that enables every individual to achieve his or her potential to participate in social and economic processes. Chronic undernutrition and ill health, especially during fetal growth in the womb and in the first three years of life has the potential to compromise – in ways that are not completely understood – critical capacities across an individual’s life cycle. Moreover, nutritional insults and illness at this stage also have a complex influence on intergenerational health outcomes – both biologically and socially. India carries a large portion of the world’s disease and malnutrition burden, a condition that persists within and in turn perpetuates cycles of poverty and impedes human development. As an important player in the economy, ICICI

Bank, the largest private sector bank in India, believes that its role should extend beyond the commercial sector to address certain fundamental issues that prevent the country from reaching its potential for rapid and participatory economic growth and development. Based on the evolving Early Child Health practice of ICICI Bank’s Social Initiatives Group this presentation will examine some of the critical scientific, socioeconomic and systemic challenges confronting efforts to reach quality health and nutrition to the poor in India. It will also discuss the role and potential of innovative and collaborative action-research strategies towards achieving significant and large-scale impact on early child health outcomes across urban and rural populations.



PREVALENCE OF MULTIPLE MICRONUTRIENT DEFICIENCIES AMONGST PREGNANT WOMEN IN A RURAL BLOCK OF HARYANA STATE, INDIA

Umesh Kapil, Priyali Pathak

*Department of Human Nutrition, All India Institute of Medical Sciences
Ansari Nagar, New Delhi - 110 029*

Introduction: Deficiencies of micronutrients (zinc, iron, folic acid and iodine) during pregnancy are known causes of Low Birth Weight (LBW). Studies have documented status of one or two micronutrients amongst pregnant women (PW). However, no attempt has been made to concurrently assess the prevalence of multiple micronutrient deficiencies and the factors associated with them amongst PW.

Objective: The present study was undertaken to assess the prevalence of multiple micronutrient deficiencies amongst PW in a rural area.

Methodology: A community based cross sectional survey was conducted in six villages of a rural area of district Faridabad in Haryana state, India during November 2000 and October 2001. All PW aged 18 years or more, with pregnancy duration of more than 28 weeks were enrolled. Data were collected on socio-economic status and other demographic parameters. Serum zinc, copper and magnesium levels were estimated by utilizing the Atomic absorption spectrophotometry (AAS); serum ferritin and folate was estimated by Enzyme Linked Immuno Sorbent Assay (ELISA) method and the Radio-Immuno Assay (RIA) method, respectively and serum thyroid stimulating hormone (TSH) level was estimated by the Abbot AxSYM System. Serum zinc,

copper, magnesium, ferritin, and folate levels less than 70.0 µg/dl, 80.0 µg/dl, 1.80 mg/dl, 15 ng/ml, and 3 ng/ml, respectively were considered as indicative of deficiency for respective micronutrients. The TSH levels of 4.670 and more indicated iodine deficiency status. Dietary intake of micronutrients was assessed utilizing 1-day 24-hour dietary recall methodology. Food consumption pattern was assessed utilizing the food frequency questionnaire methodology.

Results: Nearly 73.5, 2.7, 43.6, 73.4, 26.3, and 6.4 percent PW were deficient in zinc, copper, magnesium, iron, folic acid and iodine, respectively. The highest concurrent prevalence of two, three, four and five micronutrient deficiency was of zinc and iron (54.9%); zinc, magnesium and iron (25.6%); zinc, magnesium, iron and folic acid (9.3%) and zinc, magnesium, iron, folic acid and iodine (0.8%), respectively. No pregnant woman was found to have concomitant deficiencies of all the six micronutrients. Dietary intake data revealed an inadequate nutrient intake. Over 19% PW were consuming less than 50% of the recommended calories. Similarly, 99, 86.2, 75.4, 23.6, 3.9 percent of the PW were consuming less than 50% of the recommended folic acid, zinc, iron, copper, and magnesium. The consumption of food groups rich in micronutrients (pulses, vegetables, fruits, nuts and oil seeds, animal

foods) was infrequent. Univariate and Multivariate logistic regression analysis revealed that low dietary intake of nutrients, low frequency of consumption of food groups rich in micronutrients and increased reproductive cycles with short interpregnancy intervals were important factors leading to micronutrient deficiencies.

Conclusion: There was a high prevalence of micronutrient deficiencies amongst the PW of the area, possibly due to the poor dietary intake of food and low frequency of consumption of food groups rich in micronutrients. The concurrent prevalence of two, three, four and five micronutrient deficiencies were common.



HAEMOGLOBIN CONCENTRATION IN PREGNANCY AND ITS INFLUENCE ON SIZE AT BIRTH

Dr S Otiv

Department of Obstetrics and Gynaecology, KEM Hospital, Pune

It is usually believed that iron deficiency anaemia is very prevalent in Indian mothers and that it contributes to both foetal and maternal morbidity. This reflects in the National Anaemia Prophylaxis Program, which prescribes iron and folate to all pregnant women.

Objective.

- 1). To assess prevalence of anaemia in 2nd and 3rd trimester in women in the Pune Maternal Nutrition Study.
- 2). To study the association between maternal haemoglobin concentration and pregnancy outcome including offspring size at birth

Results. Mean Hb concentration at 18 wks gestation was 11.5 ± 1.4 g% and at 28 wks gestation it was 11.1 ± 1.5 g%. At 18 wks 29% and at 28 wks 42% women were Anaemic (Hb <11g%). Only a fifth of these anaemic women had microcytic anaemia, less than 1% had macrocytic anaemia. Moderate anaemia (Hb 7-10 g%) was present in 12.3 % women at 18 wks and 20.1% at 28 wks, severe anaemia (Hb < 7g %) was present in < 1% women.

Haemoglobin concentration was directly related to systolic and diastolic blood pressure ($r \sim 0.12$, $p < 0.01$ for all). Higher haemoglobin at 18 and 28 weeks gestation was directly associated with higher total calorie, fat, carbohydrate and protein intake ($r \sim 0.1$, $p < 0.05$, for all).

Haemoglobin concentration was not related with socio economic status or serum albumin concentration.

The maternal haemoglobin concentration at 18 or 28 wk gestation in mothers experiencing adverse pregnancy outcomes (abortion, foetal anomalies, pre term deliveries, stillbirth, early and late neonatal death) was not significantly different compared to those with normal pregnancy outcome.

Birth weight was inversely related to maternal haemoglobin concentration ($r = -0.09$, $p < 0.05$), hematocrit ($r = -0.07$, $p < 0.05$), MCV ($r = -0.08$, $p < 0.04$) and MCH ($r = -0.10$, $p < 0.008$) and serum albumin concentration ($r = -0.07$, $p < 0.04$) at 28 weeks gestation but not at 18 weeks gestation. Birth weight had no significant association with maternal serum ferritin, red cell count, MCHC or platelet counts. The fall in haemoglobin concentration, hematocrit, red cell count and serum albumin between 18 and 28 weeks gestation was not related to birth weight. All above relations were adjusted for gestation at delivery, maternal BMI, parity and baby's gender.

Anaemic mothers gave birth to heavier babies (2663 vs 2601, $p = 0.07$) adjusted for gestation at delivery, maternal BMI, parity and baby's gender.

Multivariate analysis confirmed an independent inverse relation between maternal haemoglobin concentration at 28 weeks and offspring birth weight when adjusted for gestation, baby's gender, maternal size and serum albumin concentration.

Conclusion. Anaemia was present in 30 – 40% of pregnant women in PMNS. Maternal haemoglobin concentration at 28 weeks gestation was inversely related to offspring birth weight. Anaemic women gave birth to heavier babies and did not have excess pregnancy related morbidity.



THE EFFECT OF A PARTICIPATORY INTERVENTION WITH WOMEN'S GROUPS ON BIRTH OUTCOMES IN NEPAL: CLUSTER RANDOMIZED CONTROLLED TRIAL

Dharma S Manandhar, David Osrin, Bhim Prasad Shrestha, Natasha Mesko, Joanna Morrison, Kirti Man Tumbahangphe, Suresh Tamang, Sushma Thapa, Dej Shrestha, Bidur Thapa, Jyoti Raj Shrestha, Angie Wade, Josephine Borghi, Hilary Standing, Madan Manandhar, Anthony M de L Costello, and members of the MIRA Makwanpur trial team.

Summary

Background: Neonatal deaths in developing countries make the largest contribution to global under-five mortality. 90% of deliveries in the poorest quintile of households occur at home. We hypothesised that a community-based participatory intervention could significantly reduce neonatal mortality rates.

Methods: We pair-matched 42 geopolitical clusters in Makwanpur district, Nepal, selected 12 pairs randomly, and assigned one of each pair randomly to the intervention. In each intervention cluster (average population 7000), one woman facilitator convened nine women's group meetings monthly. The facilitator supported groups through an action learning cycle in which they identified local perinatal problems and formulated strategies to address them. We monitored birth outcomes in a cohort of 28 931 women, of whom 8% joined the groups. The primary outcome was neonatal mortality rate. Other outcomes included stillbirths and maternal deaths, uptake of antenatal and delivery services, home care

practices, infant morbidity and health care seeking.

Findings: From 2001 to 2003, the neonatal mortality rate was 26.2 per thousand (76 deaths/2899 live births) in intervention clusters compared with 36.9 per thousand (119 deaths/3226 live births) in control, adjusted odds ratio 0.70 (95% confidence interval 0.53, 0.94). Stillbirth rates were similar in both groups. The maternal mortality ratio was 69 per 100 000 (2 deaths/2899 live births) in intervention compared with 341 per 100 000 (11 deaths/3226 live births) in control clusters, adjusted odds ratio 0.22 (95% confidence interval 0.05, 0.90). Women in intervention clusters were more likely to have antenatal care, institutional delivery, trained birth attendance, and hygienic care.

Interpretation: Birth outcomes in a poor, rural population improved dramatically through a low cost, potentially sustainable and scalable participatory intervention with women's groups.



DYNAMICS OF A FOOD BASED FIELD TRIAL IN SLUMS; MUMBAI MATERNAL NUTRITION PROJECT (MMNP)

**Ramesh Potdar, Nick Brown, Caroline Fall, G Subbulakshmi, Parvez Kosgi, Vijaya Taskar,
Mira Gandhi*

Background, hypothesis, methodology of Mumbai maternal Diet Study (MMDS) have been presented earlier. Smooth and streamlined conduct of such a trial entails:

a) Production and distribution of a scientifically standardized, palatably acceptable, daily variant of a single food item to be consumed on-the-spot and under supervision, in between mealtimes, six days a week by eligible women for at least one year.

b) Recording and accounting for inward/outward migrations, fasting and festivity practices, massive data generation and management, tracking the subjects through 3

months of pre-pregnancy and 9 months of pregnancy by regular home visits, food frequency questionnaires, blood tests and ultrasound scans, all in the field of urban slums, and finally ensuring accurate anthropometry of babies born at many different places within 48 to 72 hours after birth.

Trials and tribulations of MMNP team while crossing over potential, apparent and real hurdles will be outlined. Importance and feasibility of up-scaling possibly positive results of such a scientific trial into public domain will be briefly discussed to justify the formidable cost.



DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL OF THE EFFECTS OF ANTENATAL MULTIPLE MICRONUTRIENT SUPPLEMENTATION ON BIRTH WEIGHT AND GESTATIONAL DURATION IN NEPAL

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Summary

Background: Neonatal mortality is the biggest contributor to global under-five mortality, and low birth weight is a crucial underlying factor. We tested the hypotheses that antenatal multiple micronutrient supplementation would increase infant birth weight and gestational duration.

Methods: We conducted an individually randomized, double-blind controlled trial in Dhanusha district, Nepal. Participation was offered to women attending for antenatal care with singleton pregnancies at up to 20 weeks gestation. 1200 participants received either routine iron and folic acid supplements or a multiple micronutrient supplement providing a recommended daily allowance of 15 vitamins and minerals. Supplementation began at a minimum of 12 weeks gestation and continued until delivery. The study is registered as an

International Standard Randomised Controlled Trial, number ISRCTN88625934.

Findings: Birth weight was available for 523/600 infants in the control group and 529/600 in the intervention group. Mean birth weight was 2733 g (SD 422) in the control group and 2810 g (SD 453) in the intervention group, representing a difference of 77 g (95% CI 24-130 g) and a relative fall in the proportion of low birth weight by 25%. There was no difference in the duration of gestation, infant length, or head circumference.

Interpretation: In a poor community in Nepal, consumption of a daily supplement containing a recommended daily allowance of 15 micronutrients in the second and third trimesters of pregnancy was associated with increased birth weight when compared with a standard iron and folic acid preparation.



NEWBORN SIZE, INFANT AND CHILDHOOD GROWTH, AND BODY COMPOSITION AND CARDIOVASCULAR RISK FACTORS AT 6 YEARS; THE PUNE MATERNAL NUTRITION STUDY

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Size at birth and early life growth may influence risk of coronary heart disease (CHD), type 2 diabetes and the Insulin Resistance Syndrome (IRS). We measured size at birth and serial growth in infancy and childhood in 698 (370 boys, 328 girls) children born in the Pune Maternal Nutrition Study and studied their association with cardiovascular (CV) risk factors: blood pressure, serum total and HDL-cholesterol, triglycerides and glucose tolerance, insulin resistance (HOMA) and body composition at 6 years of age. Royston's conditional Z score method was used to assess independent effects of growth at different ages. (Royston *et al. Stat Med* 1995; 14:1417-36).

Larger size at birth and size in infancy and childhood (weight, height, head & mid-upper arm circ) predicted higher total fat and lean mass at 6 years ($p < 0.001$ for all). Skinfolds at birth did not predict fat or lean mass at 6 years; however skinfolds in infancy and childhood predicted fat mass at 6 years. Larger conditional weight gain in infancy and childhood was associated higher fat and lean mass at 6 years, greater conditional increase in height and mid-upper arm circumference (MUAC) was associated with higher lean mass at 6 years and higher conditional gain in skinfolds between 2 and 6 years predicted higher fat mass at 6 years.

There was no significant relationship between any of the birth measurements and any of the CV risk factor outcomes at 6 years. Blood pressure was inversely related to birth weight only after adjusting for current weight so that children with the highest blood pressure were

those who were born lighter but grown heavier. In contrast to our findings in 4 and 8-year old urban children, there were no associations between other CV risk factors and size at birth after adjustment for current size. Size at 1 year was not predictive of CV risk at 6 years, however, higher weight at 4-6 years, larger height at 3-6 years, and larger MUAC at 5-6 years predicted higher systolic blood pressure and insulin resistance (HOMA) at 6 years ($p < 0.01$ for all, adjusted for current size); head size and triceps skin folds in infancy and childhood were unresponsive. Larger subscapular skinfold at 1-4 yrs predicted lower plasma HDL cholesterol concentration.

Conditional (sex specific) analysis revealed lower birthweight to be predictive of higher systolic blood pressure and triglyceride concentrations at 6 years. Growth in first 6 months was in general not predictive of CV risk factors at 6 years, except that a lesser increase in MUAC predicted higher HOMA-R at 6 years ($p < 0.01$). Greater conditional weight gain and increase in MUAC in childhood predicted higher systolic blood pressure ($p < 0.01$ for all) and higher insulin resistance (HOMA) at 6 years ($p < 0.01$ for all).

Summary: By themselves neonatal measurements and size at 1 year did not predict CV risk at 6 years. Childhood measurements predicted body composition and CV risk at 6 years. Conditional analysis revealed that relatively smaller birthweight and rapid childhood growth predicted some CV risk factors at 6 years.

PRINCIPAL COMPONENT ANALYSIS OF MATERNAL DIET DURING GESTATION TO PREDICT 6-YEAR OUTCOMES IN THE CHILD

Fisher D and the Pune Maternal Nutrition Study investigators

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The Pune Maternal Nutrition Study is a prospective, population-based study of maternal nutrition and pregnancy outcome based in 6 rural villages near the city of Pune. Mothers were enrolled pre-pregnancy, and were studied at 18 and 28 weeks gestation. Mothers' diet was recorded using a Food Frequency Questionnaire, which listed 113 named foods grouped into 17 categories. Babies were measured at birth and every 6 months subsequently. At 6 years cardiovascular disease (CVD) risk factors such as glucose tolerance, insulin resistance and serum lipids and DEXA were measured.

Our hypotheses were that maternal intake of micronutrient-rich foods would be associated with lower levels of CVD risk factors in the child at 6 years, and that maternal intake of calcium-rich foods would be associated with greater bone mineral content and density (as measured by DEXA) in the child at 6 years.

Analyses using particular foods or food groups to predict outcomes at 6 years will be presented separately. A different approach that was tried was principal component analysis, which seeks to define general dietary patterns in contrast to individual foods. It compresses a large number of variables into a smaller number of new variables that retain as much original information as possible. In this case, the 17

categories describing maternal diet were compressed into 2 'components' at 18 weeks gestation. The first component can be interpreted as a measure of 'overall food consumption' – a greater or lesser quantity of *all* foods – whilst the second component can be interpreted as the degree to which the diet is high in fruit, vegetables and pulses and low in starchy carbohydrate.

Child's age, sex and birthweight and mother's socioeconomic status and pre-pregnancy weight were adjusted for in all analyses with the exception of those analyses where a measure of birth size was the dependent variable. Analyses involving CVD risk factors were further adjusted for child's 6-year weight.

The analysis showed that greater overall maternal food consumption was associated with larger birth size as measured by weight, length, and head, arm and chest circumference ($p < 0.01$ in all cases) but not skinfolds or foot length, and also with larger 6-year body size (weight, height, BMI, head circumference and skinfold) in the child ($p < 0.01$ in all cases except 6-year height: $p = 0.03$). Greater maternal consumption of fruit, vegetables and pulses and less starchy carbohydrate was associated with lower fasting ($p = 0.01$) and 30-min insulin ($p = 0.007$) and insulin increment ($p = 0.002$) and resistance ($p = 0.01$) in the child at 6 years. There were no

significant associations with other variables such as blood pressure, serum lipids or glucose tolerance. Greater overall maternal food consumption was also associated with greater bone mineral content, density and volumetric density in the child at 6 years ($p < 0.001$ in all cases).

In conclusion, larger overall food consumption by the mother early in the pregnancy is associated with larger body size in the child at

birth, and this association is still present at 6 years of age. At this time the child is also likely to have greater bone mineral content and density. In addition, a diet high in fruit, vegetables and pulses and low in starchy carbohydrate is associated with lower levels of CVD risk factors in the child at 6 years. Most of these associations are also present at 28 weeks gestation, but the associations are weaker and the principal components are not as easy to interpret.



EFFECTS OF MATERNAL AND PATERNAL BIRTHSIZE ON OFFSPRING CARDIOVASCULAR DISEASE RISK: AN INTERGENERATIONAL STUDY IN SOUTH INDIAN ADULTS

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Introduction: Studies in diverse population show associations between low birth weight and diabetes and coronary heart disease (CHD) in adult life. The extent to which this association reflects programmed effects of fetal under nutrition ('fetal origins') and/or common genes causing low birthweight and adult disease ('fetal insulin') hypothesis is not known. We have examined this issue by studying the relationship between maternal and paternal birthsize and offspring CHD risk factors in South Indian adults.

Methods: Birth records preserved over a period of 70 years at Holdsworth memorial hospital (HMH) enabled us to identify 415 mother offspring and 296 father offspring pairs born in HMH. Measurements on parents aged 33-65 years and offspring aged 20-46 years included anthropometry, OGTT, insulin and lipid profile, blood pressure, ECG and Rose chest pain questionnaire, smoking, alcohol consumption and social class.

Results: Offspring birthweight was inversely related to their own 120-minute glucose, insulin resistance, glucose intolerance (impaired glucose tolerance(IGT)/ impaired fasting glycaemia(IFG)/diabetes mellitus (DM)), total

cholesterol, triglycerides, waist hip ratio(WHR) and subscapular triceps ratio (SSTR) ($p < 0.01$ for all) adjusted for offspring sex, age and body mass index (BMI). Both maternal and paternal birthweight were inversely related to offspring syndrome x (OR 0.4(95 % CI: 0.3, 1.0); $p = 0.057$ for mothers; OR 0.3(95 % CI: 0.08, 0.9); $p = 0.031$ for fathers). Paternal but not maternal birthweight was inversely related to offspring insulin resistance ($\beta = -0.1$ (95 % CI: -0.3, +0.08); $p = 0.3$ for mothers; $\beta = -0.2$ (95 % CI: -0.4, +0.01); $p = 0.06$ for fathers). We found inverse relationships between maternal birthweight and offspring systolic blood pressure ($\beta = -2.5$ (95% CI: -5.03, -0.07); $p = 0.04$) and WHR ($p = 0.03$). We also found an inverse relationship between offspring birthweight and maternal CHD risk (OR 0.3 (95 % CI: 0.1, 0.9); $p = 0.04$) but not paternal CHD risk (OR 1.6 (95 % CI: 0.5, 5.3); $p = 0.4$).

Conclusions: In conclusion our study provides support to the fetal insulin hypothesis and indicates that at least part of the association between low birthweight and insulin resistance is genetic. The study also provides evidence for intergenerational effects on vascular disease transmitted through the mother, which are likely to have an environmental component.



THE METABOLIC SYNDROME AND ASSOCIATED LIFESTYLE FACTORS AMONG YOUNG INDIAN ADULTS

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Background: India is experiencing an epidemic of type 2 diabetes and cardiovascular disease, with an increasingly younger age of onset. Metabolic syndrome or Insulin resistance syndrome is considered a strong risk factor for the development of coronary artery disease. Recent studies showed cardiovascular morbidity and mortality have markedly increased in subjects with metabolic syndrome. This syndrome is particularly common among Indians who, in general, have a lower body mass index as compared to the Western population. Early recognition of the metabolic syndrome and the appropriate management is essential to prevent advent of cardiovascular complications later.

Objective: This paper presents the current prevalence of metabolic syndrome and its relationship to early and current life style factors in a large cohort of young Indian adults.

Methods: 2218 men and women (mean age 28 years) were studied from a population based birth cohort of 10,670 individuals born during 1969 to 1973 in Vellore town and nearby rural areas. Family history, socioeconomic status, physical activity, tobacco and alcohol use were recorded. Subjects had standard oral glucose tolerance test. Prevalence of metabolic syndrome is defined according to WHO protocol. Logistic regression was used to examine the relationship between life style factors and metabolic syndrome. Mean SD scores of BMI calculated at birth (ponderal index), infancy, childhood, adolescence and adulthood for all subjects who developed

metabolic syndrome compared with those of the others who did not.

Results: The subjects' median adult BMI was 20.0 kg/m². The overall prevalence of metabolic syndrome was 7.6%. (rural: 5.9%, urban: 11.5%, p<0.001). Men had higher prevalence of metabolic syndrome than women (9.7% versus 5.2%, p <0.001) The prevalence of obesity (BMI=25 kg/m²) was 8.6% in rural men, 8.8% in rural women, 16.7% in urban men and 26.1% in urban women. The metabolic syndrome in men was associated with higher body fat percent and increased alcohol consumption after adjusting with other life style factors. In women, it was associated with higher body fat percent and increased subscapular triceps skinfold ratio. Those who developed metabolic syndrome had a low BMI in childhood and an accelerated increase in BMI between childhood and adulthood compared with rest of the cohort (p<0.001). Birth weight did not show any relationship with the occurrence of metabolic syndrome in both men and women after adjusting for adult life style factors.

Conclusion: Our data suggests high prevalence of metabolic syndrome in young Indian adults, with urban prevalence almost twice as the rural group. Obesity is more prevalent in urban women, thrice as in rural women. Modification of life style factors with a balanced dietary intake and regular physical activity from childhood is likely to be beneficial in preventing the onset of metabolic syndrome.

DETERMINANTS OF MATERNAL HYPERGLYCAEMIA 6 YEARS AFTER DELIVERY

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Objective: To study the determinants of maternal hyper-glycemia 6 years after delivery in the Pune Maternal Nutrition Study (PMNS).

Study Design: The PMNS has information on maternal pre-pregnant size, socio-economic status, education and her nutritional and metabolic information during pregnancy. Children were measured in detail at birth. Six years after delivery we measured glucose tolerance and other cardiovascular risk factors in these mothers.

Results: Out of 668 (87% of original cohort) women followed up 6 years after index delivery, 58 (9%) were hyperglycaemic (IFG + IGT + DM, WHO 1997). Hyperglycaemic women were shorter (151 vs 153 cm, $p<0.01$), heavier (48 vs 44 kg, $p<0.001$) and more adipose (DXA fat % 31 vs 25, $p<0.001$) compared to normoglycaemic women. They also had higher blood pressure (115/69 vs 107/64, $p<0.001$), higher plasma total cholesterol (149 vs 139 mg%, $p<0.01$), triglycerides (85 vs 61 mg%, $p<0.001$) and lower HDL-C (43 vs 46 mg%, $p<0.05$) concentrations and were more insulin resistant (HOMA-R 1.68 vs 1.14, $p<0.01$). There was no difference in their socio-economic status, but they had gained more weight since index delivery (2.90 vs -0.46 kg, $p<0.001$). In the index pregnancy (28 weeks gestation) these

hyperglycaemic women had higher fasting and 2-hour plasma glucose concentrations (75 vs 72 mg% and 89 vs 79 mg% respectively, $p<0.001$ both), were less physically active (Score 55 vs 67, $p<0.001$) and had higher blood pressure ($p<0.05$). Only 2 of these were diagnosed as IGT during pregnancy. There was no difference in HOMA insulin resistance and lipid measurements in the 2 groups of mothers during the index pregnancy nor were the weight gain, rates of anaemia, PIH and assisted deliveries different in the two groups. Babies of subsequently hyperglycaemic mothers had similar birth size measurements as those of normoglycaemic mothers. Hyperglycaemic mothers were more obese (BMI 18.6 vs 17.9 kg/m², $p<0.05$) and more adipose (fat % 23 vs 21, $p<0.001$) even before pregnancy, though their SES, education and family history of diabetes were similar to the normoglycaemic mothers.

Conclusion: Hyperglycaemic young rural Indian mothers were shorter and fatter from before pregnancy and had minimally elevated glycaemia (within 'normal' range) during pregnancy compared to the normoglycaemic mothers. They were physically less active during pregnancy and showed the metabolic syndrome and elevated cardiovascular risk.



GROWTH AND BODY COMPOSITION, AND GLUCOSE/INSULIN METABOLISM IN INDIAN CHILDREN – RELATIONSHIPS TO MATERNAL GESTATIONAL DIABETES: PARTHENON FOLLOW-UP STUDY

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Aim: To describe the pattern of growth and body composition during the first five years of life and glucose/insulin concentrations at five years in relationship to maternal gestational glucose tolerance in south India.

Methods: We studied 830 pregnant women attending the antenatal clinics of the Holdsworth Memorial Hospital (HMH), Mysore. They underwent an oral glucose tolerance test (OGTT) at 30+/-2 weeks. 674 of these women delivered at HMH. Detailed anthropometry was performed on the offspring at birth, and annually thereafter. 585 mothers returned with their offspring at 5 years of age for detailed investigations including OGTT for glucose and insulin concentrations, bio-impedance for fat estimation and blood pressure measurement. Parents' anthropometry and glucose/insulin measurements were done in the mean time.

Results: The Mysore babies were small compared to UK neonates, but the deficit varied for different body measurements. While birthweight (-1.1 SD) was considerably lower, crown-heel length (-0.3 SD) and subscapular skinfold thickness (-0.2 SD) were relatively spared. At five years, subscapular skinfold thickness was larger than the UK standards (+0.23 SD, $p < 0.001$) despite all other body measurements being significantly smaller.

(Figure 1) Findings at 5-years were similar in comparison with another standard, based on Dutch children. At 5-years, girls in the cohort had higher insulin concentrations and were more insulin resistant. Body fat was the strongest predictor of glucose and insulin concentrations independent of other body components and parental characteristics. Taller children were more insulin resistant and had significantly higher insulin measurements at five years. Newborns of the mothers with gestational diabetes were larger in all the measurements than those of non-diabetic mothers. These differences were considerably diminished during infancy and were not significant at 1 year of age. By 5 years, female offspring of diabetic mothers were again significantly more adipose and had bigger weight and arm circumference. Offspring of gestation diabetic mothers had increased insulin concentrations at 120-minutes. Even in the offspring of non-diabetic mothers, increase in maternal gestational insulin concentrations increased 30-minute insulin (Figure 2) and insulin increment in the child at five years.

Future plans. The cohort is being followed up six-monthly in order to observe the timing of 'adiposity rebound' in these children. A selected subset of these children are being monitored for physical activity levels.

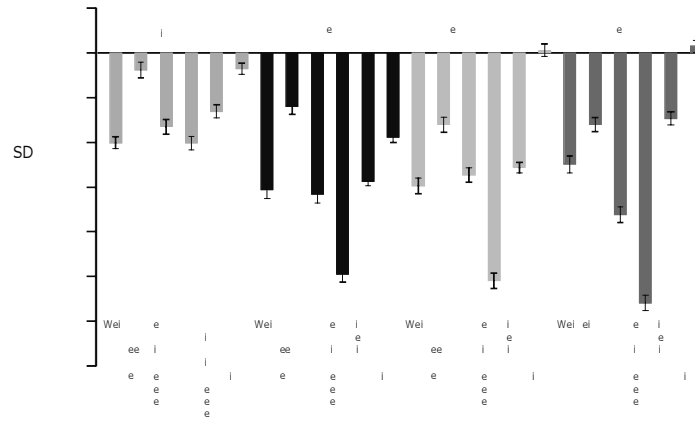


Figure 1.
Mean SD scores (with 95% CI) for anthropometry at birth, 1, 2 and 5 years
(Relative to the UK population)

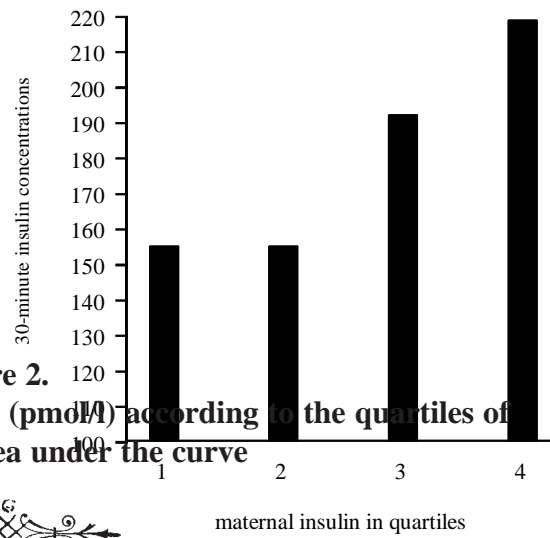


Figure 2.
Mean 30-minute insulin concentrations (pmol/l) according to the quartiles of
maternal insulin area under the curve



CHILDHOOD OBESITY IN OFFSPRING OF MATERNAL DIABETES: STUDIES IN THE NORMAL POPULATION SUGGEST MATERNAL OBESITY NOT MATERNAL GLYCAEMIA DETERMINES EARLY CHILDHOOD BMI

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Offspring of mothers with type 2 diabetes (T2D) and gestational diabetes are not only born heavier but remain obese in early childhood. The mothers have increased obesity as well as being hyperglycaemic. We investigated the relative effect of maternal glycaemia and BMI on early growth in non-diabetic pregnancies.

We studied 548 non-diabetic mothers and fathers with singleton pregnancies. Offspring anthropometry was measured at birth, 12 weeks, 1 and 2 years and standard deviation scores calculated.

Maternal fasting glucose (MFG) at 28 weeks gestation, was positively correlated with weight ($r=0.19$, $p<0.001$) at birth but not 12 weeks, 1 or 2 years. Maternal BMI was correlated with

weight at birth ($r=0.28$, $p<0.001$) and postnatally ($r=0.15-0.22$, $p<0.001$). Paternal BMI was correlated with offspring weight at 1 and 2 years ($r=0.22$, $p<0.001$). The correlations with parental BMI and offspring weight correlated with offspring BMI not height.

In non-diabetic pregnancies, maternal glycaemia impact on offspring weight was lost after 12 weeks but the association between maternal and offspring BMI persist up to 2 years. The association of fathers' BMI with offspring BMI is consistent with this reflecting an early genetic influence. Increased obesity in offspring of mothers with T2D and gestational diabetes may therefore reflect maternal obesity rather maternal hyperglycaemia in utero.



EARLY LIFE UNDERNUTRITION, POSTNATAL GROWTH AND RISK OF NON-COMMUNICABLE DISEASES IN YOUNG ADULTS FROM RURAL INDIA

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Early life undernutrition is a major problem in rural India and therefore consideration of postnatal growth becomes important in examining FOAD hypothesis. Postnatal period comprises of pre-school age (early life 0-3+ yr), pre-pubertal (6-10 yrs) period and adolescence (11-15 yr) and offers a child various options for changing growth trajectory, all of which are not examined for its effect on later risk of diseases. We studied young rural adults (n=275, 19-25 yrs) for antropometry and fasting blood parameters. These subjects were also studied earlier for their growth during the postnatal period in a longitudinal study. Subjects having high BP had higher attained weights and BMI during adolescence, than their counterpart, while in case of those with dyslipidemia it was true even during pre-pubertal growth. In contrast, subjects with high sugar had significantly higher heights during adolescence.

Comparison of z-scores for subjects in risk & no risk category also showed similar trends. Logistic regression after controlling for age and adult height showed highest odds ratio for high sugar (3.9, $p<0.05$) for wasting in early life, while in case of dyslipidemia (16.6, $p<0.05$) it was the pre-pubertal period. However for children who had normal weight and height in early of life and were in highest tertile of adult BMI showed high OR (3.1, $p<0.05$) for high BP. This was also true for subjects stunted during early life and shifting to high adult BMI (OR 2.7). Subjects who were undernourished (wasting or stunting) during early life but had high adult BMI showed highest prevalence for all the three diseases. In particular, higher weight changes were associated with BP and dyslipidemia while higher height changes were associated with risk for high sugar.



DOES SUPPLEMENTAL NUTRITION IN EARLY LIFE REDUCE LATER RISK OF CARDIOVASCULAR DISEASE?

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Aims: It has been suggested that undernutrition in early life can permanently program an individual's future risk of cardiovascular disease. Observational studies linking size at birth to later outcomes have been extensively replicated, but it is unclear whether these associations reflect the role of maternal diet in pregnancy or fetal nutrition due to placental or genetic factors. We therefore examined cardiovascular disease risk among the offspring born to a cohort of chronically undernourished, non-smoking women. About half of these women were resident in an area with an ongoing programme of supplemental nutrition for pregnant women and children under the age of 6 years.

Methods: The birth cohort was prospectively established to assess the impact of food supplementation (500 calories, 25 grams protein, for 300 days a year) on pregnancy outcome. Fifteen villages with the programme and 14 villages without the programme were selected from one area of rural south India, and all women who became pregnant during 1986-1990 were recruited. Baseline data were collected on these women during stages of pregnancy, and their offspring during the first year of life. In the present follow up, we traced the children born in this cohort and invited them to attend a locally arranged clinic, where we collected information on their health and lifestyle, and measured their height, weight, skinfolds, waist-hip circumference, and blood pressure. Arterial stiffness (radial artery

augmentation index) was assessed by the non-invasive technique of applanation tonometry, and a fasting blood sample was collected to measure glucose, lipids and insulin. So far, follow up has been completed in 27 villages: 1,343 children have been traced, of which a further 1,043 (78% response rate) have been clinically examined.

Results: The full results will be available after completion of follow up in December 2004. Preliminary data available on 502 children (299 non-supplemented group and 203 supplemented group) were analysed. Children in the supplemented group were slightly younger (mean age: 14.8 versus 15.1 years; $P=0.013$). There was no difference between the two groups in their sex distribution, height, weight, diastolic blood pressure or cholesterol. However, children in the supplemented group had lower mean systolic blood pressure (104.0 versus 105.9mmHg; $P=0.054$), lower arterial stiffness (augmentation index: 0.7 versus 5.7; $P<0.001$), and lower fasting serum triglycerides (82.3 versus 89.9mg%; $P=0.075$). These differences persisted even after adjustment for age and sex of the participants.

Conclusions: Preliminary results from this controlled trial suggest that better nutrition in early life among chronically undernourished populations may confer long-term benefits for cardiovascular disease risk.



INSULIN RESISTANCE SYNDROME IN INDIAN CHILDREN : CONTINUED STUDIES OF PUNE URBAN COHORT

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This paper presents current observations on growth and puberty in a cohort of urban Indian children born between 1987 and 1989. They were first examined at the age of 4 years with a glucose tolerance test and other metabolic studies, and the children with lowest birth weight were found to have a tendency to relative insulin resistance. Further follow up studies at age 8 years showed that the children with the most adverse cardiovascular and insulin resistance syndrome (IRS) risk profiles were those that were small at birth and big by 8 years. The most insulin resistant children were those who had short parents but had themselves grown tall by 8 years and we speculated that this could be due to advanced skeletal maturation and early puberty. We now report follow up studies of this urban cohort with emphasis on this high risk group, identified at age 8 years.

The cohort was followed up every year from age 11 years to record anthropometry (including skinfold thickness), blood pressure and sexual maturity rating (Tanner's SMR staging). Of the original 477 children, 387 have been assessed currently between the ages of 14 and 17 years (208 boys; 179 girls).

All the 179 girls examined have attained menarche at a mean age of $12.86 \pm$ years (range 10.33 to 16.26 years). The numbers in various stages of puberty are Stage V n = 152 (84.9%), Stage IV n = 26 (14.5%), Stage III n = 1 (0.6%). Therefore, 152 girls (84.9%) have completed their puberty. Elevated IRS variables at 8 years and current high BMI and fat mass ($p < 0.01$)

predicted early age at menarche. Mean peak height velocity (5.04 cm SD 2.6 cm) was related to age of menarche ($p < 0.01$). Mean age of completion of puberty was 15.8 years, SD 0.6 years. Fat mass at 8 years was inversely related to age of completion of puberty ($p < 0.01$). Neither age at menarche nor age of completion of puberty was related to birth weight. The most insulin resistant girls at 8 years continued to be fatter and more centrally obese (higher waist circumference) ($p < 0.01$). However, contrary to our earlier speculation the last height of this group is taller than expected as per mid parental height, but not taller than mean height of the cohort.

The SMR staging of the boys (n = 208) currently is as follows:- Stage V n = 44 (21.2%), Stage IV n = 133 (63.9%), Stage III n = 23 (11.1%), Stage II n = 8 (3.8%). All boys (n = 208) boys have testicular volume ≥ 8 mls. Further analysis has not been carried out as many boys have not completed their puberty as yet.

To conclude, the most insulin resistant girls at 8 years have shown early menarche, early peak height velocity and earlier completion of puberty. The group has higher fat mass, central obesity and higher BP but are not shorter than expected as per mid parental height. This group of girls therefore continues to remain a high risk group for IRS. Such analysis of boys awaits their full growth. The decision re age for the complete metabolic reassessment of the cohort needs discussion.



AYURVEDIC BODY PROPORTION AND ITS ASSOCIATION WITH MODERN PARAMETERS OF ADIPOSITY AND DIABETES

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Background: Ayurveda has associated good health with proportionate body phenotype. The unit of measurement is the breadth at the base of middle finger (Anguli Pariman). Specific proportions are described for different body parts in relation to height. Excess or smaller proportions indicate deranged adipose tissue. Adipose tissue derangement is a cause of Prameha (Diabetes).

Design and Methods: Ninety-four men and 98 women in Pune Maternal Nutrition Study also underwent Ayurvedic body proportion measurements (height, arm span, lengths of forehead, ears, nose, face, neck, upper arm, elbow to tip of the middle finger, knee to ankle and feet). For each subject, the measurements were first recorded in cms to the left side and then were standardized to angulis by dividing each measurement with the value of one anguli of the respective subject (Swanguli). We report the relations of the body proportions with adiposity and metabolic markers of diabetes risk.

Results: All the anguli measurements in men and women (Mean age 34y and 27y respectively), (except the length of fingers, upper arm and neck), were smaller than the

Ayurvedic standards (for height mean difference from standard (84) for men -5.0, $p < 0.001$ and women -2.8, $p < 0.001$). We found following associations after controlling for age, height and weight. In men, short forehead, face, and little finger predicted higher fasting and 2h plasma glucose ($r \sim -0.25$, $p < 0.05$ all). In men, short ears predicted high cholesterol and high triglycerides ($r = -0.25$, $p < 0.05$ both). In women, short forehead predicted high cholesterol ($r = -0.25$, $p < 0.05$) and short neck predicted low HDL ($r = 0.26$, $p < 0.05$). Also, in women, short armspan, neck, upper arm, fore arm and calf predicted higher triglycerides ($r \sim -0.25$, $p < 0.05$ all), whereas long calf predicted higher FPG ($r = 0.29$, $p < 0.01$). In women, short neck predicted high diastolic BP ($r = -0.24$, $p < 0.05$) and long length of upper extremities predicted high BP ($r \sim -0.30$, $p < 0.05$ all).

Conclusion: Both in men and women, smaller length of different measurements (facial, neck and upper extremities) predicted higher risk of diabetes and cardiovascular disease while in women, longer legs were predictive of higher fasting plasma glucose. Our study confirms the predictive significance of Ayurvedic proportions for risk of diabetes and cardiovascular disease.



MENDELIAN RANDOMIZATION : PROSPECTS AND LIMITATIONS

Shah Ebrahim & George Davey Smith, University of Bristol

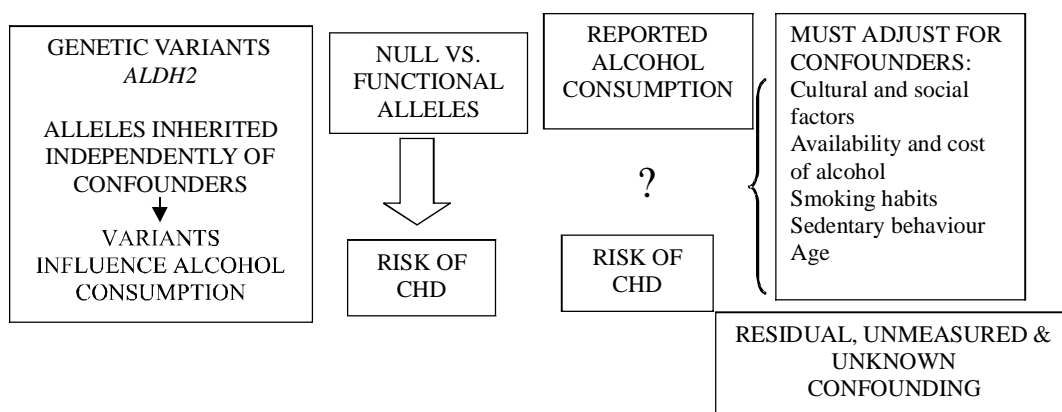
Mendelian randomization is the term applied to the random assortment of alleles at the time of gamete formation. This results in population distributions of genetic variants that are independent of behavioural and environmental factors that typically confound epidemiologic associations between putative risk factors and disease (see Figure). In some circumstances this can provide a study design akin to randomized comparisons. The principles of Mendelian randomization can serve to limit several potential problems in observational epidemiology, chiefly confounding and reverse causality.

Mendelian randomization approaches have the potential to contribute to an improved understanding of the aetiological importance of environmental factors in common chronic diseases, through reducing the influence on estimated associations of confounding, reverse causation, and various other sources of bias. Categories of inference from Mendelian randomization studies involve propensity to

being exposed to a risk factor, proxies for intermediate phenotypes, modifiers of environmental exposures, studying intergenerational exposures, and in identifying the broad categories of exposure that may be aetiologically important, and thus should be investigated further.

Limitations of the approach must be acknowledged. These include: failure to establish reliable genotype – intermediate phenotype or genotype – disease associations; confounding of genotype – intermediate phenotype – disease associations; pleiotropy and the multi-function of genes; canalization and developmental stability; lack of suitable polymorphisms for studying modifiable exposures of interest. Most of these limitations are common to any genetic epidemiology enterprise and the most important should be reduced through application of the growing knowledge provided by the study of functional genomics.

Alcohol and CHD associations viewed from observational epidemiology and Mendelian randomisation



COMPARISON OF PHYSICAL ACTIVITY SCORES WITH PHYSICAL ACTIVITY RECORDED BY ACCELEROMETER: PROBLEMS AND PITFALLS FACED IN A PILOT STUDY

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Assessment of physical activity is carried out by various methods, including by administering a questionnaire, by using a movement sensor, a heart rate sensor, a combination of both these sensors, doubly labelled water or whole body calorimetry. However in the field situation, none of the sophisticated gold standard methods is easily available or practical. Hence the need exists for an objective method for a reasonably accurate assessment of physical activity.

A short pilot study was undertaken to determine the accuracy and validity of physical activity scores derived as a summary estimate of daily physical activity recorded by 10 individuals in log sheets as compared to the activity records obtained from these persons using an accelerometer (CSA Actigraph). Work-related activity and additional time spent each day in domestic activities (eg sweeping, washing) and leisure activities (eg., walking, cycling) were recorded. Periods of time for each activity were multiplied by metabolic constants, derived from the relative energy expenditure of activities and summed¹. The accelerometer was worn over the right hip continuously during waking hours for 7 days of normal daily activities and later again for 7 days when the person carried out regular physical exercises. The data record was downloaded from Actigraph into excel files and the counts obtained are classified into four categories: light, moderate, hard and very hard activity.

Rank correlation test was employed to evaluate the results. The magnitude of the correlation during a 7-day period of normal daily activities for each individual ranged from 0.32 to 0.86. The extent of correlation during the week of regular physical exercises ranged from 0.21 to 0.82.

The poor correlation obtained may be explained by several problems encountered during the study. Illiterate subjects were unable to fill in the log sheets and needed the help of the field staff. Recall of the daily events in this situation is likely to be poor and the time record only very approximate. Honest reporting of events is lacking often. Removal of the monitor any time during the study will also need to be recorded. Physical activity scores do not cover all the activities carried out by the individual and will need to be modified to suit Indian conditions, eg. a construction worker's activities. All movements are recorded by the accelerometer and yield counts, eg. travelling by bus or a two-wheeler. Strenuous exercises like carrying a heavy load is also recorded only as a movement and does not vary proportionately with the weight of the load.

To assess physical activity or exercise in a future study, it will be essential for the subjects to be consistent in writing their log sheets while on or off continuous monitoring by the accelerometer.

¹ WHO Technical Report Series 1985; No.724



PHYSICAL ACTIVITY (PA) ASSESSMENT IN ADULTS AND CHILDREN

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An apparent association exists between physical inactivity and health problems such as obesity. There is evidence of upward trends in body mass index (BMI) and body fat, which are related to physical inactivity. Measurement of PA will then be relevant to some of the DOHAD studies. PA may itself be programmed. It may act as a confounder in early life effects on body composition. If we are considering interventions to increase PA (to prevent obesity and DM) we need to know if PA or energy expenditure (EE) is actually increased by the intervention we choose.

To assess PA, essential information on the duration, frequency, intensity/strenuousness and even the purpose of the activity is required. There is an array of tools available for capturing such information: diaries or logs, questionnaires, performance tests for fitness and accelerometer devices. The pros and cons of each are related to logistics, time, cost, personnel requirements as well as processing the quantity of data. The data generated by the one device, the CSA accelerometer, and its implications for use will be described further.

The working premise is that if we measure movement then we are able to know an individual's true PA and EE. One additional dimension to consider is that of fitness, which indicates how familiar the body is with PA and

is linked to cardiovascular health. Most investigators aim to measure EE, but accelerometers are designed to measure movement as given by counts (units of movement). As such, one strength of the CSA is its ability to detect when activity changes and reflect the type of activity by the counts. Problems with the CSA lie with the count cut-offs that are used to categorise an individual's time spent on light, moderate and high intensity type activities. Another is with the use of regression equations for calculating EE. Both count cut-offs and regression equations are not necessarily applicable to populations in India.

A proven method of determining EE is factorial analysis, which uses a diary of activities and estimates of Basal Metabolic Rate (BMR). It relies on information on the duration of the activities, METs/PARs (constants used as multiples of BMR for different activities) and body weight. From these, the EE of an activity can be derived. Factorial analysis will be compared with CSA data using pilot data from Vellore.

Alternative ways of calibrating the CSA monitors are currently being sought using log/diary methods and conducting observation sessions while participants carry out standard tasks. This is with an aim of characterizing the types of activity, determining a range of

plausible counts and finally resetting the count cut-offs so that new and appropriate categories (e.g. light, moderate and high) can be generated.

We are currently at the exploration stage and

are trying to find ways of using these CSA monitors correctly. It is understood that if we employ more methods than the accelerometer alone, then we will be able to better assess true PA and EE.



FOOD INTAKE AND PHYSICAL ACTIVITY IN PUNE URBAN CHILDREN COHORT STUDY

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Objective: To study present dietary intake and physical activity pattern of Pune urban cohort children in association with their current BMI and related parameters.

Methodology: The cohort children are being followed up annually as described earlier. A pilot study on 100 consecutive children of the cohort was carried out to assess details of diet and physical activity. The dietary assessment was carried out using; 1. One-day recall and two-day diary method & 2. Food frequency questionnaire. Daily energy expenditure was calculated using physical activity ratios and estimated BMR.

Results: 6 non-compliant children were excluded from analysis. The 94 children studied were aged between 15 and 17 years & they were studying in X, XI or XII standards. 50% (n=47) were girls. The mean calorie intake of the whole group per day was 1714 Kcal \pm 468 (x for girls 1534 Kcal and x for boys 1895 Kcal). The mean daily protein and fat intake were 50gm \pm 13.6 and 48gms \pm 18 respectively. Mean fat intake of > 20% of total daily calories was seen in 71 children (76%). The calculated mean servings for vegetables (cooked and raw) was 1.6 \pm 0.9

& for fruits was 0.6 \pm 0.4 (as against recommended servings of at least 3 and 2 respectively). Present BMI, skinfolds and waist circumference did not correlate with present calorie, fat or vegetable intake but correlated inversely with protein intake ($p < 0.05$). Salad and fruit intake correlated inversely with waist circumference. ($p < 0.05$).

The mean number of hours spent on TV and tuitions were 2.4 \pm 1.9 and 4.1 \pm 1.9hrs, respectively. Sport and physical activity was calculated as 'light' in 50 children (53%), 'moderate' in 32 (34%) and 'heavy' in 12 children (13%). Heavier physical activity correlated inversely with BMI, sum of skinfolds and with lower waist circumference. Mean calculated daily energy expenditure of the whole group was 1932 Kcal \pm 336 (range 1330 to 2843 Kcal). However, the inverse correlation with BMI did not reach statistically significant proportions.

Conclusions: The dietary and activity analysis of cohort children shows a considerably higher intake of fat and lower intake of fruit and vegetables as compared to RDA standards. Only a minority of the children are engaged in strenuous sport and physical activity.



PREVENTION OF OBESITY IN INDIAN SCHOOL CHILDREN: A PROPOSED 'LIFE STYLE' PROGRAMME IN SYMBIOSIS SCHOOL PUNE

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Background: Childhood obesity is now well established as an important factor in the development of adult chronic disease such as diabetes mellitus (DM) and coronary heart disease (CHD). Both DM and CHD have now reached alarming epidemic proportions in urban India. The features of obesity of particular relevance in Indian children are: central obesity, higher 'adiposity', rapid gain in weight in early childhood especially in LBW babies, early menarche with earlier fat spurt in adolescence and persistent childhood obesity. Recent surveys in urban areas in India have shown that more than 30% of adults and more than 10% of school children are overweight or obese (numbers reaching 30% in well off schools!) Sedentary life styles with emphasis on study, tuitions and computers are obviously as responsible as too much of 'good' food and too little of exercise and sports. School based intervention appears to be the most logical attempt at interrupting the epidemic of obesity and thereby, DM and CHD.

Hypothesis: It is possible to reduce the prevalence of childhood obesity by a school based intervention programme.

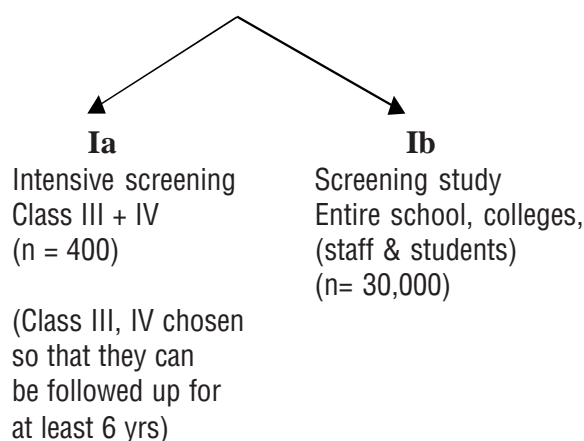
Symbiosis School: Situated in the elite Deccan Gymkhana area of Pune. Classes from Std. I to Std. X. Each class has four divisions (approximately 50 children in each division).

Total No. of children 2181. Total number of staff (teaching and non teaching) n = 91. Caters to high socio-economic classes. Average fees per month Rs.1,000. The school has a mid day meal programme. PT lessons are compulsory twice a week. The school has a good reputation in both academics and extra curricular activities.

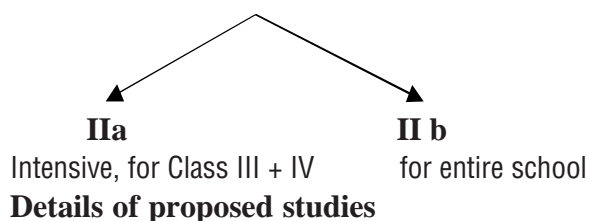
Symbiosis Institute of Health Sciences was established in 1997 and provides curative and preventive services to entire Symbiosis Educational Institutions (no. of students = 35,000). Annual health checkup of school children was started in 1997 & recorded serially in health cards .

Proposed Plan for study

Phase I – Prevalence studies



Phase II – Intervention Studies



Details of proposed studies

Phase Ia (Prevalence studies for Class III & IV)

1. Every child to be studied in details for anthropometry, BMI, waist circumference and skinfolds. Height, weight and BMI will be plotted on NCHS centiles (repeated 6 / 12 monthly for at least five years).
 - Special investigations (proposed) – Baseline and repeat after 5 years: Blood pressure, DEXA, Biometric impedance, muscle mass (urinary creatinine excretion) and insulin resistance.
2. History of the child: Attempts will be made to ascertain birth weight and toddler weights and heights.
3. Parents and siblings: Anthropometry, blood pressure and history of medical problems will be assessed once in five years.

Phase Ib Prevalence study – cross sectional for entire staff and student: Height, weight BMI and waist circumference and history of diseases (if any) will be assessed as a screening study on the entire Symbiosis Educational Institutions (n=30,000)

Phase II Intervention studies

For entire school

1. Health education – Diet, Nutrition, Life styles, Obesity
 - A. Demo / lectures once a week (invited speaker) — 1 hr / week
 - B. Incorporate in science class (class teacher) — 15mins. daily

2. Physical activity / games — hr / daily
3. Health and physical activity — Scoring subject
4. Mid day meal programme — Caloric modifications
5. No hawkers

For Class III & IV

Identify overweight and obese children as per NCHS centiles and Cole's cut off's (expected 20% = 80). Also, to identify centrally obese (waist circumference) and preobese (crossing centiles) and adipose (? DEXA)

These children will be for intensive monitoring, i.e. visit to the dietician / MSW daily / weekly (15 mins.)

Increase physical activity to be monitored (aerobics, dance, swimming) at least 30 mins. a day.

Weight to be monitored once a week.

Outcomes to be studied

Class III & IV students to be monitored every year in details for next 10 years.

- Obesity and overweight prevalence now and compare with 5 and 13 years hence
- ? compare with prevalence of overweight in similar other schools with no intervention programmes.
- Assess life style change if any (time spent on sports, T.V, eating habits etc.,)

Studies so far:

A pilot study has been carried out in the year 03-04. The prevalence of overweight in Std. III and IV was 9.79% (Frank Obesity was 1.67%).

Preliminary discussions with parents showed great enthusiasm towards participation in such a programme.

INCREASING NON-COMMUNICABLE PREVALENCE IN YOUNG ADULTS FROM RURAL INDIAN POPULATION

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In addition to the problem of low birth weight, early life undernutrition, especially in first three years of life, has been characteristically high in many rural populations in India. As such they are likely to have higher risks of NCDs in view of the Barker hypothesis. However, studies reported on young adults from rural populations in India are not many. We therefore investigated young rural Indian boys (n=275; 19-25 yrs.) from villages around Pune for anthropometry and fasting blood parameters. The prevalence of high blood pressure (Systolic BP \geq 130 mmHg and Diastolic BP \geq 80 mmHg) was 21.8%, high sugar (fasting blood sugar \geq 100 mg/dl) was 14.4% and dyslipidemia (Triglyceride \geq 150 mg/dl or Cholesterol \geq 200 mg/dl, or HDL-Cholesterol $<$ 35 mg/dl) was 9.6%. The prevalence of high BP was above 10% even in the lower tertiles of BMI, BF, sum of skinfolds, WHR, abdomen and waist, while for high sugar and dyslipidemia it was highest in higher tertile of BMI (20.6 kg/m²), body fat (16.7%), sum of skinfolds (29.0mm), abdomen (73.5cm), waist (71.5cm) indicating that the risk for high BP is seen much earlier and relatively

at lower levels of all these parameters, compared to that for high blood sugar and dyslipidemia. On crossclassifying individuals according to BMI and sum of skinfolds, it was observed that the body fat appeared to be important determinant of NCD risk, as in individuals with low BMI (slim) risk for all three diseases was higher if skinfolds (sum) are higher, but the effect of higher skinfolds is prominent for hypertension and dyslipidemia especially among individuals with high BMI. On crossclassifying individuals according to height and abdominal circumference (indicator for central obesity), it was observed that subjects who were not centrally obese but had shorter heights (below 166.7 cm) had higher values of all risk parameters, indicating that NCD risks are associated with long-term undernutrition. Short and centrally obese individuals had highest risk for hypertension as well as dyslipidemia. Our data shows considerably higher NCDs in rural young adults who are hardly overweight by any criteria and are physically active, thus suggesting possible consequences of intra-uterine nutritional insults.



BODY COMPOSITION AND HYPERGLYCEMIA IN MIDDLE-AGED INDIAN MEN

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Introduction: India and other developing countries are experiencing a rapidly escalating epidemic of diabetes. Obesity is a major risk factor for this epidemic. Obesity measured as body mass index (BMI) underestimates adiposity of Indians. There are very few population-based studies of body fat measurements in Indians. In CRISIS (Coronary Risk of Insulin Sensitivity in Indian Subjects) study we studied body composition of 441 adult Indian men from rural and urban residence. Body composition was measured as fat and fat free mass by Bioelectrical Impedance Analysis, calibrated against deuterated water method.

Methods and Results: The mean age of the subjects was 38 years, with a BMI of 22 kg/m² and 26 % body fat. Proportions of adipose men (>25% body fat, 55%) was considerably higher than the obese (BMI >30 kg/m², 5%). One fifth of the men were hyperglycemic (OGTT, WHO, 1997). Population attributable risk for hyperglycemia (IGT+DM) of adiposity was five times higher than the risk due to obesity. Of the body composition measurements, fat mass was significant predictor (p<0.000) while fat free

mass did not predict hyperglycemia. On controlling these results for height, both, fat mass and fat free mass directly predicted hyperglycemia (p<0.001 both). We studied regional distribution of fat by Dual X-ray Absorptiometry in a subgroup of 150 men. These men had 12.0kg (26%) total body fat of which 2% (of body weight) was in arms, 7% in legs, 11% was in the trunk region. Hyperglycemia was directly predicted by trunk fat and inversely by leg fat. In the same subgroup we studied hepatic fat by Computed Tomography; this was found to be a direct predictor of hyperglycemia independent of total body fat (p<0.001).

Summary: Our results show that current WHO BMI cut-points for obesity underestimate adiposity as well as risk of hyperglycemia. Generalised as well as central adiposity contributed significantly to hyperglycemia. In presence of central adiposity lower limb adiposity seems to be protective. Higher fat free mass is not protective against hyperglycemia, especially in short and fat men.



A STUDY OF MULTIVITAMIN PRESCRIPTION PRACTICE IN EARLY PREGNANCY

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Background. Vitamin B12 deficiency is widely prevalent in India especially in vegetarians. It is common practice to prescribe folate in larger than recommended doses, for prevention of neural tube defects as well as later in the first trimester of pregnancy. This could have adverse metabolic effects in the mother and the foetus. However the prescribing practices of folate and vitamin B12 in early pregnancy are not known.

Objectives. To study the prescribing practices of folate and vitamin B12 pregnant women attending the antenatal clinic at KEM Hospital, Pune in the first half of pregnancy until 20 weeks gestation.

Results. Prescriptions of 93 women who came for a booking antenatal visit in the first 20 weeks of gestation were studied. The mean gestation age at booking was 13 weeks (range 6 to 19 weeks). None of the women had received any vitamin before the booking visit including vitamins for prevention of neural tube defects. After booking 8 women (8.6%) were not

prescribed any vitamin till 20 weeks gestation.

Among the 85 women who received any vitamin, 42 women (49.5%) received both folate and vitamin B12. Whereas 22 women (25.8%) received folate alone without vitamin B12, 21 women (24.7%) were prescribed vitamin B12 alone without folate.

Folate was prescribed in the dose of 5 mg daily to 19 women (22.3%) and in the dose of 1.5 mg daily to 42 women (49.4%).

Vitamin B12 was prescribed in the dose of 5 mcg daily to 19 women (22.3%), in the dose of 15 mcg daily to 26 women (30.5%) and in the dose of 400mcg daily to 12 women (14.1%).

Conclusion. More than 90% pregnant women were prescribed either folate or vitamin B12 or both at their antenatal visits up to 20 weeks gestation. About 50% women received both folate and vitamin B12, and 25% women each received folate alone or vitamin B12 alone.



PREVALENCE OF OBESITY AMONG ADOLESCENT BOYS FROM URBAN AFFLUENT POPULATION IN PUNE

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Obesity in growing children is of special concern as the probability of tracking it into adulthood is very high. Since there is scarcity of data on adolescent obesity in India we studied boys (n = 1151) in the age 10- 16 years from schools catering to children from affluent class. Body weight, height, body fat (%), skinfold thickness (triceps) and blood pressure were measured. Additionally, socioeconomic information, physical activity and consumption of specific foods were recorded. Prevalence of obesity (wt for age > 120%) was significantly (p <0.01) higher (31.2%) in children below 12 years age compared to older (age > 14 years)

children (20.6%). All the measurements including systolic blood pressure (SBP) were significantly higher for obese children compared to non-obese, in every age group. Children (%) reporting outdoor games decreased significantly as BMI, weight, body fat % and triceps skinfold increased. Prevalence for high SBP increased suddenly beyond 25 % of body fat, beyond 12.2 mm skinfold at triceps, 45 kg body weight and BMI value of 22 kg/m². These findings suggest that averting adolescent obesity among urban affluent population is essential for reducing risks of non-communicable adult diseases in later life.



TRANSCUTANEOUS ABSORPTION OF TOPICALLY MASSAGED OIL IN NEONATES

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Objective: To study the transcutaneous absorption of traditionally massaged oil in newborns and to specifically compare the effects of (i) essential fatty acid (EFA) rich – safflower oil and (ii) saturated fat rich coconut oil, on fatty acid profiles of massaged babies.

Design: A short term randomised controlled study.

Setting: Tertiary care NICU of a large teaching hospital and a research laboratory of a University complex.

Methods: 120 study babies were randomly assigned to three oil groups (i) safflower oil (n=40) (ii) coconut oil (n=40) and (iii) no oil controls (n=40). In each group, babies were selected in three subsets as per their gestational ages viz., (a) < 34weeks, (b) 34-37 weeks, (c) > 37 weeks. 5mls of the designated oil was massaged four times a day (6hrly) for five days under controlled conditions of temperature and feeding. Pre and post oil massage samples of

blood were analysed for triglycerides and fatty acid profiles using gas chromatography.

Results: Post oil triglyceride values were significantly raised in both the oil groups and also in controls. However, the quantum of rise was significantly higher in oil groups as compared to controls ($p<0.05$). Fatty acid profiles (gas chromatography) showed significant rise in EFAs (linolenic acid and arachidonic acid) in safflower oil group and saturated fats in coconut oil group ($p<0.05$). Changes were more evident in term babies. There were no side effects associated with the massage.

Conclusion: This study shows that topically applied oil can be absorbed in neonates and is probably available for nutritional purposes. The fatty acid constituents of the oil can influence the changes in the fatty acid profiles of the massaged babies.

Key words: *Traditional oil, topical absorption, fatty acid profile.*



FAST VS SLOW ENTERAL FEEDING IN BABIES LESS THAN 1.5 KG BODY WEIGHT WITH SPECIAL REFERENCE TO THEIR EARLY OUTCOME

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INTRODUCTION

A preterm infant represents a major challenge¹ in nutritional management being born during a period of extremely rapid growth. The foetus normally trebles in weight between 24 and 36 weeks gestation, and many nutrients are laid down predominantly during the final trimester, so that the preterm are born with low body store. For example body fat increases from 1% of body weight at 20 weeks to around 15% at term. These low reserves combines with immature metabolic responses and co-existing illness influence the ability of preterm infants to survive in the short term and consequences for their later health and development. Also the intra-uterine malnutrition and therefore early preterm malnutrition leads to coronary heart diseases, hyperlipidemia, NIDDM and hypertension, later in their life.

AIMS AND OBJECTIVES

This study was designed to test the hypothesis², that rapid advancement of enteral feeding in babies <1.5 kg body weight improves outcome, in the form of hospital discharge, incidence of sepsis, neonatal-necrotising enterocolitis (NNEC), biochemical profile and neurodevelopment outcome in the first year of life.

METHODS AND MATERIALS

- All stable neonates with birth weight <1.5 kg are included in the study

- They are randomized³ into the fast advancement group (increment of 20ml/kg/day) and slow advancement group (i.e. increment of 10ml/kg/day).
- The primary objective of this study will be to observe the time taken by this infant to establish full enteral feeds (ie 180ml/kg/day).
 - The secondary objective of this study is to find out the incidence of NNEC, Apnoea, Hyperbilirubinemia, and electrolytic imbalance.
 - The monitoring during feeding are daily weight record, abdominal girth measurement, and the amount of gastric residue and mortality rate.

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NONINVASIVE EVALUATION OF ENDOTHELIAL FUNCTION AND ARTERIAL MECHANISMIN CHILDREN OF HYPERTENSIVE PARENTS

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Forty (40) asymptomatic normotensive and non-obese children (11-18 years) were evaluated for endothelial function. Of these 20 were children of parents who were suffering from essential hypertension and the other 20 who were children of normal parents, were recruited as controls. High resolution untrasonography was performed to measure flow mediated and glyceryl trinitrate induced dilation in brachial artery and arterial mechanics in common carotid artery.

Results

Brachial artery flow meditated vasodilation was decreased in children of hypertensive parents ($0.16 \pm 0.007 \text{ cm Vs } 0.075 \pm 0.130 \text{ cm } p = < 0.05$) as compared to controls, because there is decreased production of nitric oxide by endothelium in children of normotensive parents. But the subsequent post glyceryl

trinitrate (GTN) dilation was comparable in both the groups ($0.16 \pm 0.014 \text{ cm Vs } 0.056 \pm 0.11 \text{ cm } p = 0.45$) because GTN directly acts on vascular muscle and not on endothelium. Carotid intima media thickness (C- IMT) was comparable ($0.051 \pm 0.008 \text{ cm Vs } 0.050 \pm 0.004 \text{ cm } p = < 0.45$) in both the groups and no statistical difference was noted.

Conclusions

It is concluded that children of hypertensive parents do have evidence of endothelial dysfunction which could be an early marker for development of coronary artery disease. Since this is a first pilot project of its 'kind, a similar study of larger' dimension involving a larger section of pediatric population is indicated to give a definitive result with far reaching implications and future directions.



PARENTAL ROLE IN THE PREVENTION OF ADOLESCENT OBESITY

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Adolescent obesity is emerging as one of the major health problems in developing countries, especially among affluents, due to changing dietary and physical activity patterns. Along with short-term implications like poor social functioning and impaired academic performance, it also has long-term implications in terms of increased risk for Non-communicable diseases. Therefore prevention of adolescent obesity is essential. The subjects for the present study will be from urban school in Pune, where 11% were assessed to be obese and 10% as overweight. As children may become resistant to change when involved directly in intervention program, we propose a model based on parents as exclusive agents for bringing out desired change. It has been documented that parents play an important role in development of proper eating habits and appropriate physical activity patterns. In-fact

parent's participation in such intervention will create an environment conducive for child's active participation in intervention program. Our approach for preventing adolescent obesity includes informative and interactive sessions for parents (4) in first four months of intervention, (12) sessions one per month with obese subjects and (1) session, initially with concerned school teachers. Each session would highlight a particular theme, would have demonstrations of nutritional recipes and important information will be given to subjects and parents on flash cards. We have also developed weekly monitoring system for recording diet and activity pattern. Such an approach has not been documented in India. We wish to demonstrate that such family based approach not only has multiple benefits but can also be used as model to be integrated in educational systems.



OBESITY AND NCD RISKS IN URBAN AFFLUENT POPULATION

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Developing countries like India are witnessing sharp increase in the prevalence of Non Communicable Diseases (NCD). Owing to nutritional transition, significant changes in dietary practices and physical activity are known to increase obesity prevalence in such populations. We therefore, investigated associations of obesity and NCD risks among Rotarians (n=466; 30-60 yrs) from Pune. Obesity was defined as BMI ≥ 26 , a cut-off from ROC analysis, which was at the 50th and 48th percentile for male and female subjects respectively. Prevalence of hypertension (sBP ≥ 140 mmHg and dBP ≥ 90 mmHg) and dyslipidemia (Cholesterol ≥ 200 mg/dl or TG ≥ 150 mg/dl or HDL ≤ 35 mg/dl) was significantly higher among obese than non-obese subjects

(35.4 Vs 19.0, 56.4 Vs 40.5 respectively) but it was not so for increased fasting blood glucose (FBG ≥ 100 mg/dl). Prevalence of hypertension (22.2) doubled in the presence of heredity (45.1) and tripled (63.0) in presence of both obesity and heredity, in case of individuals ≥ 45 years. In case of dyslipidemia the prevalence (50.0) however, increased marginally (63.4) in the presence of both indicating lower influence of these factors. But for increased fasting glucose, influence of heredity alone was seen (24.5 Vs 36.6). Our data thus indicates that BMI cut-off is more meaningful for risks of hypertension and dyslipidemia but not for increased glucose. It is also worthwhile to note that the cut off is lower for Indians than that for western population.



CLUSTERING OF NONCOMMUNICABLE DISEASE RISK VARIABLES AMONG YOUNG RURAL INDIAN POPULATION

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Clustering of Non Communicable diseases (NCDs) risk variables was examined in young adults (aged 19-26 yr., n=275) from rural India. The analysis considered variables such as BMI, Systolic BP, fasting blood sugar, triglyceride and HDL-C as continuous variables to compute Intra-Class Correlations (ICC) or as categorical variables (> sex specific tertile value) for calculating risk ratios (observed/expected frequency). Among the combinations of two risk variables, ICC for BMI and Systolic BP was the strongest (0.3075, $p<0.01$) in males as well as in females (0.3101, $p<0.01$). In contrast, the correlation between BMI and HDL-C were the weakest. For set of three variable clustering, ICC was significantly higher with addition of TG/HDL-C (ratio of triglycerides to HDL-C) as a risk variable in case of males (0.2473, $p<0.01$) while it was true for blood sugar in

case of females (0.2227, $p<0.01$). Higher adult BMI thus seems to increase risks for BP initially in both sexes followed by altered lipid levels in males and blood sugar levels in females. The risk ratios for clustering of adverse levels of all five-risk variables, was 5.41 for males ($p<0.01$) and 5.88 for females ($p<0.01$). These risk ratios were three fold higher for children under nourished during 0-4 years age and shifting to high adult BMI as compared to those who were normal earlier and had shifted to high adult BMI. In contrast higher weight status during pre-pubertal or adolescence coupled with high adult BMI increased such risks of clustering of NCDs. Results indicate that undernutrition in early life or weight gain beyond preschool age increased risk for clustering of NCDs in these young rural adults.



CORONARY HEART DISEASE AND GLUCOSE INTOLERANCE IN THE FIRST MYSORE COHORT RESTUDIED AFTER 10 YEARS

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In the first Mysore study (1991-1993) 518 men and women born in Holdsworth Memorial Hospital during 1934-1954 were traced, matched to their birth records, and studied. They were assessed for the presence of coronary heart disease (CHD: major Q waves on ECG, typical angina by Rose questionnaire, or history of bypass surgery/angioplasty), and glucose tolerance, blood pressure and serum cholesterol and triglyceride concentrations were measured. Anthropometry was carried out data on socio-economic status, family history, and tobacco and alcohol consumption was obtained by questionnaire.

In 2003-2004 these individuals were re-traced (aged 49-69 years). Of the original 518 subjects, 383 agreed to take part in the repeat study. Of the remainder, 56 were known to have died, 48 were unwilling to participate, 24 had moved away from Mysore, and for 7 no details were available. Investigations were the same as those performed in the first study. For subjects who had died, families were asked if the deceased had been diagnosed by a doctor as having (a) diabetes or (b) a heart attack (prior to or at the time of death).

Of those who had CHD in Study 1 (n=52), 62% no longer satisfied the criteria for CHD, indicating that the diagnostic criteria are highly unreliable. Nevertheless, the prevalence of CHD

at Study 10 and the risk of death from heart attack were higher in subjects labelled CHD in Study 1 (15% and 13% respectively) than in those with no CHD in Study 1 (4%: RR=3.76; $p<0.001$ and 3%: RR=5.21; $p<0.001$). The prevalence of CHD was inversely related to birthweight, even when cases were limited to those who remained CHD in Study 10 ($p=0.05$). The incidence of *new* CHD or death with/from heart attack was also inversely related to birthweight (<2.5kg: n=10 (9.3%); -2.9kg: n=14 (8.2%); >2.9kg: n=6 (5.5%)) though this trend was not statistically significant ($p=0.3$). Of the risk factors measured in Study 1, older age, presence of diabetes and higher triglyceride concentrations were associated with an increased risk of developing new CHD or dying from a heart attack having had no CHD in Study 1 ($p<0.05$).

Of 332 men and women with a normal OGTT in Study 1, 7% had impaired glucose tolerance (IGT), 1% had impaired fasting glucose (IFG) and 5% had diabetes (DM). Of 99 subjects with IGT or IFG in Study 1, 11% remained IGT/IFG and 32% had DM. Thirteen (18%) subjects with diabetes in Study 1 had died (RR=1.61; $p=0.1$, compared with non-diabetics). Higher ponderal index at birth was associated with an increased prevalence and incidence of diabetes ($p=0.001$ and $p=0.06$ respectively, unadjusted). In contrast to our findings in Study 1, maternal

pregnancy weight was unrelated to the risk of diabetes in study 10. There were no significant linear or U-shaped associations between IGT or IFG and size at birth or maternal measurements. Of the factors measured in Study 1, higher BMI, waist/hip ratio and insulin resistance (HOMA), and a positive family history for diabetes were associated with a significantly increased risk of developing diabetes in the next 10 years.

The data suggest that low birthweight was a risk factor for incident CHD in the 10 years following the original Mysore study. However the data highlight the unreliability of 'epidemiological' methods of diagnosing CHD, the need for a larger sample size, and the problems created by losses to follow up. Higher ponderal index at birth was a risk factor for incident diabetes, but the risk of developing IGT or IFG were unrelated to early-life measurements.



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