SUMMARY AND CONCLUSION

"Third World" transitions have created jeopardy of NCD's in India; also affecting a provincially small city like Vadodara. The broad objective of the present study was to develop, execute and coordinate a multi-strategic healthy school programme "MARG" based on the lifestyle and nutritional status of affluent school children.

The specific objectives were i) Assessment of nutritional status of children (8 – 14 yr) studying in the selected schools from Urban Vadodara; ii) School evaluation based on the CDC's Coordinated School Health Approach; iii) Development, execution and coordination of "MARG" – A Multi-Strategic Healthy School Programme based on Socio-Ecology Model of Behaviour Change and iv) Promotion of physical activity in one of the selected schools and assessing its impact on the nutritional status of children.

The study "MARG" was conducted in 10 purposively selected, coeducational English medium schools, catering to students of middle and higher income families in urban Vadodara. In **phase 1a,** data on the background information, parental history of non-communicable disease, dietary behavior and physical activity pattern and anthropometric measurements were done on all children enrolled in std 4-9th (n=6472) . For school evaluation under **phase 1b**, Critical Qualitative Research (CQR) design (secondary data, observation, meetings, interviews and discussions) was used for evaluating the 8 components (Health Education, Physical Education, Health Services, Nutrition Services, Counseling, Psychological and Social Services, Healthy and Safe School Environment, Health Promotion for Staff, Family/Community Involvement) stated under CDC's CSHA. The schools were evaluated using a "Component Score Scale". The school canteen were evaluated using a semi-structured questionnaire and the menus were evaluated using three different scales namely the CFRS, colour grading scale and ingredient scale.

In **phase 2,** "MARG" a multi-strategic Healthy School Programme was implemented. Three systems MICRO, MESO and EXO of behaviour change Socio Ecology Model, were selected for implementing "MARG" involving all 6472 students (intra and interpersonal stage), their parents (parent and community stage), principals and teachers (organizational stage). Nutrition health education under "MARG" was delivered by using a combination of media (electronic and print) and hands-on learning activities. The programme was coordinated by a team of peer students and teachers and impact was assessed using appropriate feedback forms.

For **phase 3**, 1/10 schools was purposively selected for execution of "Active Sports Club" and based on informed consent, 169 participants were enrolled for moderate-vigorous-physical-activity (MVPA) intervention of 90 days (45 min for 6 days a week). Impact on this intervention was judged by assessment of the height, weight, waist and hip circumference, BAZ, WHR, WHtR, TBF%, systolic and diastolic BP, and biochemical parameters (CBC, CRP, Lipid profile and blood glucose).

The results of the Phase 1a, revealed that out of the parental history NCD of 6472 children, among all the morbidities, parental history of obesity showed highest significant difference between age groups ($X^2 = 74$, $p<0.001$) followed by school types ($X^2 = 7.7$, $p<0.01$) and least among the gender ($X^2 = 6.6$, $p<0.05$). Fruits and vegetables were consumed daily by 24% students; whereas 22% - 38% students showed maximum preference for sugar dense foods, followed by fried foods (32%). Aerated drinks and foods made up of refined wheat flour were consumed by were consumed by 10% and 12% students 2-6 times a week. As much as 46% students were sedentary activities and just half of the same, 21% students were involved in activities of vigorous intensity. Boys of young age group (55%) performed physical activity of moderate intensity as compared to the girls. Moreover children studying in public schools were 5.4% more physically active than children studying in private school.

A clear trend of Dual Burden of Malnutrition (10% UN and 9% OW/OB) with 81% children in normal nutritional status (BAZ measured by WHO, 2010) was seen. Nutritional status as per WC revealed that 33% (Khadilkar et al., 2011) and 9% (NHANES) children were "at risk". Based on WHR and WHtR, prevalence of students "at risk" was 78% and 42% respectively; of which WHR could be computed as more sensitive indicator. Prevalence of OW/OB was more among boys and children of 8 – 11 years of age. Majority of students having maternal history of morbidities belonged to the category of normal nutritional status. WC of children significantly correlated with parental history of obesity, diabetes and heart disease at $p<0.001$. BAZ and WC have shown correlation with consumption of unhealthy foods.

Results of the Phase 1b reveal that based on the coordinated school health evaluation given by CDC, 60% schools covered more than 5 topics on nutrition, but did not have a nutritionist; physical education was a part of the school curriculum in all schools but only 50% dedicated all PE period for PE and not as free or proxy period. Health, nutrition and counseling services evaluation reveal that 40% schools had a separate nurse and rest room to take care of emergency health crises; 70% schools had food service centers and children were not allowed to bring junk food in the tiffins. However 90% schools had fast food outlet near the school vicinity and parents were not involved in decisions related to the school canteens. Only 30% schools had a psychology counselor; 90% schools had good infrastructure, adequate space and safe surroundings; 40% schools conducted annual health check up for students and staff free of cost. Parent Teachers Association (PTA) was formed in 70% schools.

Phase 2 results indicated that a behavior change model such as the Socio Ecology Model was successful in articulating various factors present in a child's eco-system that determines the child's growth and development. It provided an opportunity to develop and implement innovative programmes

in the school setting using various MICRO, MESO and EXO systems. Nutrition health Education (NHE) was delivered using electronic media through power point presentations; print media through booklets and poster and more than 50 interactive activities were organized within the school setting for hands-on learning. More than 6000 children, 2000 parents and 500 teachers could be sensitized through "MARG". Quite many community outreach activities such as exhibitions, rally and recipe competitions were also conducted.

"Peer" students and teachers were trained under "MARG" and were able to sustain the program even in the absence of the researcher. Since "MARG" and its related activities were incorporated within school setting, the school teachers were given the responsibility of assessing various activities. The jury members, and winners of these activities were felicitated with certificates. Thus, education was imparted in play-way method to children with the help of "peers", which made learning a very positive experience. Capacity building of parents could be achieved successfully under "MARG" due to the SEM model. The school – MESO system initiated sports club as a healthy concepts after "MARG" and several school services were improved such as school food services, health service, emphasis was laid on health, nutrition and physical education curriculum as a result of "MARG" intervention.

The results of the last **phase 3** which involved formulation and impact assessment of an "Active Sports Club" intervention in a school revealed that the schedule of a 35 min of football/basketball/volleyball for three days and aerobic exercise of moderate intensity for other 3 days/week followed by pranayam for 10 minutes (monitored by 5 school teachers and the researcher) for 90 working days (prior school schedule) was feasible and enjoyed by the participants.

Post intervention results show that though at baseline, 82% students had a normal nutritional status as per BAZ, 6% OW/OB and 13% UN, post

intervention, children having undernourished nutritional status shifted to a normal nutritional status, but none of the students turned overweight or obese.

The baseline TBF was 19% (5-53.7%) with higher values among girls. Boys exhibited higher BP values as compared to girls. Post intervention, there was a significant positive shift in TBF among girls (2.7 at $p<0.01$, 95% CI); yet the mean values were in the normal range. More than 35% boys and nearly 32% girls had higher TBF percent which increased by 1.5% among boys and 7.5% among girls. Both systolic and diastolic blood pressure reduced dramatically by 40% among the children of younger age group and by 15% among the children of elder age group after the intervention.

Fifty percent participants were anemic (45%, mild anemia; 1% moderate anemia); 14% had low RBC (<4.2 mil/cmm), 63% had low PCV (<32%). MCV (<78 fl) and MCH (<27 pg) were below normal among 47% and 55% participants; while only 8% participants had <32% MCHC values. Across the gender and age groups, there was a positive shift in the hemoglobin values and PCV, MCV as well as MCH.

The cholesterol and TG values significantly reduced after the 90 days of participation in the "Active Sports Club". The TG values reduced significantly among boys by 3.7 mg/dl ($p<0.001$, 95% CI) and by 2.94 mg/dl ($p<0.01$, 95% CI) among girls. Similarly the TG:HDL ratio reduced among boys by 2.9 and among girls by 2.5 at $p<0.001$ and $p<0.01$ respectively after the intervention.

The mean values of all blood glucose parameters lied in the normal range. HOMA IR values were in the range of 0.4 to 12.3 and 24% students were found to be insulin resistant (<3 – normal insulin resistance, 3-5 - moderate IR and >5 - sever IR) which remain nearly unchanged after the intervention.

Participants with normal BAZ, WC, WHR, WHtR, BP, HDL, TG and TC values had excess TBF. WHtR was found to be more sensitive parameter than the WC.TBF was commonly associated with WC and WHtR; while HDL-C, LDL-C, TG, TC: HDL ratio and FSI were some of the biochemical parameters that were commonly related among both the anthropometric indices. WC was more closely associated with the HDL-C values at $p<0.001$. Students who were categorized as overnourished had high levels of TBF percent (25.8 to 28.5±3.9), TG levels (89.8 – 95 mg/dl) and low levels of HDL-C (45 – 48 mg/dl). Subjects with higher TBF percent had significantly higher SBP, HDL-C, LDL-C, TC: HDL ratio, TG and FSI at $p<0.001$.

It can be thus concluded that genetic influence of obesity and co-morbidities have shown a potential risk factor for both boys and girls between the age group of 8 to 16 years belonging to middle as well as high income families. With regards to the dietary habits, there is only 1% difference between weekly intake of healthy : unhealthy food and large difference of 8% within a fortnight. If the current trend of dietary habits continues there is a possibility of increased consumption of the unhealthy food by school children in near future. Moreover, the time spent on physical activity is grossly insufficient among the selected students. Nutritional status cannot be assessed by just one indicator; and also there is a need to have national reference standards to reduce the chances of over or under prediction of nutritional status.

Though no public policies were made, the activities of programme "MARG" were disseminated through the school websites, annual magazines and newsletters after which, health and nutrition became an integral part of the schools. The "Active Sports Club" was a feasible effort and showed significant effect on blood pressure and TC, TG values; however, MVPA alone for such a short duration was insufficient to change the %TBF. Monitoring of the school based food service and fatty food intake by adolescents is must.