Research Reach

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EDITORIAL

In recent years, apart from their conventional roles, nutrients are being evaluated for their newer and more diverse roles in the human body. The paper by Meena Godhia and Urmi Palya attempts to looks at Vitamin D beyond its classical role in bone metabolism. The paper reviews current scientific research on the importance of Vitamin D status as a risk factor for metabolic syndrome. With the increasing realization that "fetal origin" of problems has far more long term effects than originally assumed, a great deal of current research has been focused on maternal nutrition and health. The paper by Vijayalaxmi & Asna in an effort in this direction, examines the influence of age on maternal nutritional status and pregnancy outcome.

Calcium and iron are two nutrients of critical importance during the formative years of childhood and adolescence. There is always need for additional data on their consumption patterns among different population groups. While the paper by Jacqueline Elizabeth and Sheila John looks at the food choices of adolescents with respect to calcium rich foods, the paper by Asma et al examines iron intakes and dietary iron sources in the diets of a sample of children from an urban slum in Mysore. Food intake is governed to a large extent by food color, flavor and palatability. The uniqueness of Indian cuisine is attributed to the widespread use of spices and spice mixes. The paper by Subadhra et al included in this issue reports the findings of a survey on the purchase, storage and consumption patterns of spices and spice mixes in Mumbai.

This July 2009 issue has been planned to cover a variety of research articles. Also published are reviews on the book titled "Natural dyes from botanical sources –a compendium" by Dr. E. M. Dedhia and Dr. A. Srivastava and a list of the researches conducted in the year 2008-2009 by the post graduate students of Nirmala Niketan, College of Home Science, Mumbai.

Chief Editor,
Dr. Malathi Sivaramakrishnan.

INSTRUCTIONS TO THE AUTHORS

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For Web references:

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VITAMIN D- IS IT MORE THAN A "BONE – A – FIDE" HORMONE?? SHEDDING LIGHT ON THE ROLE OF VITAMIN D IN METABOLIC SYNDROME

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The identification of vitamin D receptor expression in different tissues suggest a wide spread role for vitamin D action beyond its classical function in bone and mineral metabolism. Recently, the importance of vitamin D status as a risk factor in the development of metabolic syndrome has been the focus of several studies. The present review summarizes key research findings on the possible relationship between Vitamin D status and components of the metabolic syndrome such as insulin resistance, hypertension and dyslipidemia.

India is getting less sunlight than it did 20 years ago and increased industrial trend, urbanization, greater use of vehicles, biomass burning and some other natural causes are accelerating this trend (Padma Kumari ,Times of India, November 16' 2007). Vitamin D is taken for granted and is assumed to be plentiful in a healthy diet. Unfortunately natural dietary sources of vitamin D are limited and absence of adequate cutaneous vitamin D production increases the risk of developing vitamin D deficiency. It is well recognized that latitude, season, and time of day exert a major influence on cutaneous vitamin D_3 production. There is a significant variation in the prevalence of inadequate vitamin D status during summer and winter and at different latitudes and dietary vitamin D intakes. (Hanley et al 2005). Photosynthesis of vitamin D in the skin is higher in low latitude regions due to more UVB radiation exposure. However, living in a sunny climate alone does not eliminate low serum vitamin D levels. (Lips et al 2001). Other factors such as use of sunscreen, the amount of melanin in the skin, the type of clothing worn, and any other situation that reduces cutaneous production of vitamin D_3 (Matsuoka et al 1987,Holick et al 2005.) can interfere with adequate synthesis. During summer 7-dehydrocholesterol in the skin is most efficiently converted to pre vitamin D_3 (Webb et al 1988) from 0700 to 1700h, with a peak rate of synthesis at 1230 h. (Holick 2004). About 10-15 minutes of sun exposure of hands and arms at mid-day when sun is overhead is needed to achieve the daily requirement of about 400 IU. (Gerry et al 2007)

The prevalence of insufficient vitamin or deficient vitamin D status is alarmingly high in some groups. The prevalence of vitamin D insufficiency was 52 %, deficiency was 30% and only 18 % had normal serum 25(OH) D levels in a study by "Harinaryan et al 2004" on "South Indian Post- Menopausal Women". Similarly in another study in which "Puri et al 2007 " identified the vitamin D status of apparently healthy schoolgirls from two different socioeconomic strata in Delhi and its relationship to nutrition and lifestyle, prevalence of

biochemical hypovitaminosis D (serum 25-hydroxyvitamin D < 50 nmol/l) was seen in 90·8 % of girls (89·6 % lower socio- economic strata and 91·9 % in upper socio economic strata) Low vitamin D status is being increasingly recognized as widespread in all stages of life, even in sunny climates (Lips et al 2001 & Holick et al 2005). The relationship of vitamin D with bone metabolism is clearly established. More recently, the possible importance of vitamin D status as a novel risk factor for several chronic disease has gained more interest. This review investigates the association between Vitamin D status and several of the components of the metabolic syndrome.

Defining optimal Vitamin D status

Establishing biochemical criteria for vitamin D deficiency or insufficiency is still a matter of debate.and it differs among the investigators. There is general agreement, however, that the serum 25 (OH) D levels is the best indicator to define vitamin D deficiency, insufficiency, hypovitaminosis, sufficiency, and toxicity (Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and nutrition Board and Institute of Medicine; 1997, Mc Kenna & Freaney; 1998) (Fig 1) The establishment of so-called normal serum "vitamin D" values based on the population distribution of serum 25-hydroxyvitamin D is not appropriate, because serum 25-hydroxyvitamin D reflects the degree of sun exposure, geographic location, and level of dietary vitamin D intake of the population. Desirable levels of circulating 25(OH) D have been variously defined as 50, 80, and higher than 100 nmol/L.(Dawson et al 2005) Vitamin D "insufficiency" can range from less than 40 to 80 nmol/L. Vitamin D "deficiency" has generally been defined as a serum 25(OH) D concentration under 25nmol/L (10ng/mL). Moreover this latter cut off value can be supported by the observation that serum 1,25(OH)D, the active hormonal form of vitamin D, is positively correlated with serum 25(OH)D up to about 30nmol/L(Lips 2005), suggesting a limitation of adequate hormonal substrate at these low 25-(OH)D concentrations.

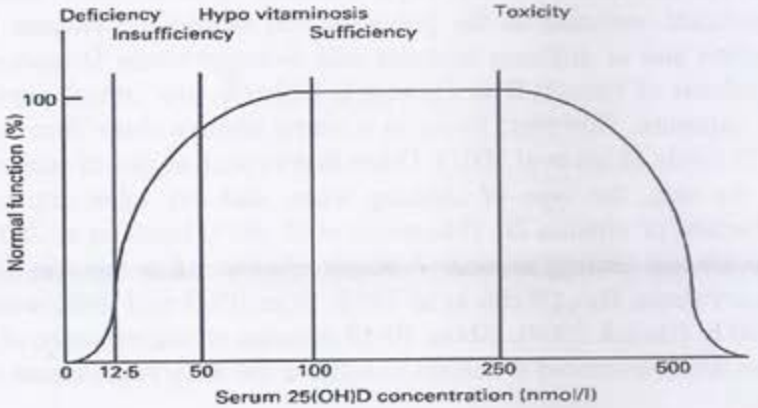

Fig 1: Stages of vitamin D status

Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, Food and nutrition Board and Institute of Medicine (1997) Dietary Reference intakes for Calcium, Phosphorous, Magnesium, Vitamin D and Fluoride, pp. 250-287. Washington, DC: National Academy of Sciences in Zitterman A(2003)"Vitamin D in preventive medicine: are we ignoring the evidence; British Journal of Nutrition;89:552-572.

VITAMIN D INTERACTIONS WITH OBESITY & COMPONENTS OF METABOLIC SYNDROME

VITAMIN D & OBESITY: Adiposity is an important determinant of serum 25-hydroxyvitamin D levels and may be primarily responsible for the association between low vitamin D status and various disease outcomes, including the metabolic syndrome. Observations in both morbidly obese individuals and healthy people support a general association between adiposity and vitamin D status. The association between increased body fat and low serum 25-hydroxyvitamin D concentrations was recognized in humans and animal models more than 30 years ago and it was hypothesized that because vitamin D is a fat soluble vitamin, it is sequestered and stored in fat tissues and muscles and then released slowly into the circulation. Bell et al demonstrated that the vitamin D endocrine system in obese subjects is characterized by changes consistent with secondary hyperparathyroidism and increased serum 1,25-dihydroxyvitamin D. PTH is a peptide hormone secreted by parathyroid gland. PTH stimulates the renal 25-hydroxyvitamin D 1 alpha hydroxylase that carries out the C-1 hydroxylation of 25-hydroxyvitamin D to 1,25-dihydroxyvitamin D (the active steroidal hormone form of vitamin D) to stimulate the calcitropic effects of vitamin D, increased calcium reabsorption, and calcium release from the bone. Bell et al. hypothesized that increased levels of the active vitamin D metabolite was responsible for reducing serum 25 hydroxyvitamin D in obese individuals through a negative feedback inhibition of hepatic 25-hydroxyvitamin D synthesis (Fig 2). Other determinants of serum 25 (OH) D concentrations in obese people may be less sun exposure associated with limited mobility or clothing habits. (Looker et al 2005 & Snijder et al 2005).

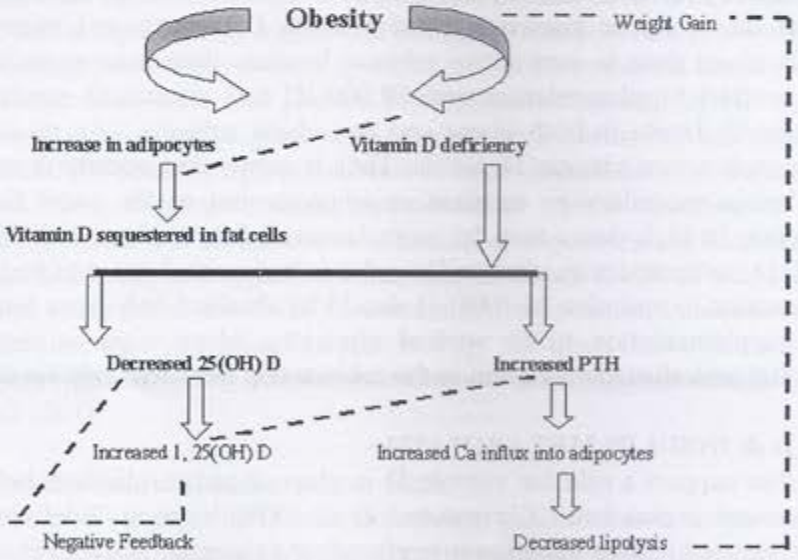

Fig 2:- Vitamin D and obesity

Low Serum 25- Hydroxy vitamin D and elevated serum PTH in obesity was investigated in a population based study by Snijder et al. Serum 25 (OH) D, PTH, BMI, body composition (circumferences, skin fold, and dual energy x ray absorptiometry {DEXA}) were evaluated in 237 men and 217 women. Total body fat was observed to be inversely associated with serum 25

(OH) D and positively associated with PTH independent of age, sex, season and study region. PTH also independently of 25 (OH) D contributes to the development of obesity. This association was even stronger when % body fat derived from DEXA measurements was used. Arunabh et al; 2003 found an association between body weight and serum 25 (OH) D in 419 healthy women enrolled in body composition study. Serum 25 (OH) D progressively decreased as the % TBF increased. After adjusting for age, race, season, and dietary vitamin D intake, a significant negative correlation between serum 25 (OH) D and %TBF was still present. Further investigation of the relationship in stepwise linear regression analysis indicated that race played the major role in predicting the serum 25 (OH) D levels followed by season and then %TBF. These findings concerning the importance of race are also consistent with the well known observation that the blacks have reduced synthesis of vitamin D in the skin due to the presence of more melanin which absorbs some of the UVB radiation needed for cutaneous vitamin D synthesis.(Matsuoka et al 1991).This is evident by the work done by Anne et a 2005 who examined the relationship between Serum 25 (OH) D and % TBF by race in 6042 women (3567 non-Hispanic whites and 2475 non Hispanic blacks) aged 12+1 yrs. There was a weaker relationship between body fat and Serum 25 (OH) D in blacks. It was suggested that body fat has lower impact in blacks because there is less vitamin D formed to sequester. More work is needed to better understand the mechanism underlying the differences in body fat and Serum 25 (OH) D by age as well as by race.

Supporting results from Vitamin D Intervention trials:
Worstman et al 2000 found that the increase in the serum 25 (OH) D levels was 57% less in obese compared with non obese subjects post irradiation to UVB ray and suggested that subcutaneous fat, which is known to store vitamin D_3 sequestered more of the synthesized vitamin D in obese than in non obese subjects because there was more fat available for this process. In contrast supplementation with 50,000 IU oral vitamin D_2 resulted in an increase in serum vitamin D_2 levels in both obese and non-obese subjects with no significant difference between the peak serum vitamin D_2 levels. Thus it seems that obesity is associated with lower vitamin D levels secondary to increase in adiposity but at the same time oral Vitamin D supplementation in high doses may be more bio-available to obese individuals for conversion into 25 (OH) D, compared with vitamin D synthesis in dermis. Impact of body fat on oral vitamin D supplementation to optimize 25 (OH) D should be obtained only from longitudinal study with vitamin D supplementation to be applied clinically. More work is needed to identify the mechanism that underlies the variation in the relationship between body fat and vitamin D status.

VITAMIN D & INSULIN METABOLISM:-
Animal studies support a role for vitamin D in glucose and insulin metabolism. The vitamin D receptor is present in pancreas.(Christakos S et al: 1979) Vitamin D deficiency impairs glucose and arginine induced insulin secretion in perfused rat pancreas.(Norman et al;1980, Kadowaki et al;1984) In vivo, vitamin D deficient rats have reduced glucose clearance and reduced insulin secretion in response to a glucose tolerant test.(Cade C et al;1986). Not only are receptors for 1, $25(OH)_2$ D_3 found in beta cells, but the effectors part of the vitamin D pathway is also present in the form of vitamin D dependent calcium binding proteins, also known as calbindin-D_{28k} (Sooy et al 1999) . The expression of calbindin-D_{28k} has been shown to protect beta cells from cytokine mediated cell death (Rabinovitch et al 2001). Studies have shown that vitamin D deficiency

reduces insulin turnover. Adequate vitamin D status facilitates the biosynthetic capacity of the beta cell and accelerates the conversion of pro-insulin to insulin (Bourlon et al 1999).The mechanism by which 1, 25(OH) $_2$ D_3 might act on insulin secretion is suggested by the significant rise in cytosolic Ca^{2+} levels observed following 1, 25(OH)2 D3 stimulated secretion of insulin by islet cells. However, additional details of a possible molecular mechanism connecting vitamin D Status and diabetes risk remains to be investigated. The effect of vitamin D on insulin secretion is also observed in humans. Several investigations have found that people with impaired glucose tolerance or diabetes have lower concentrations of serum 25-hydroxyvitamin D than do subjects with normal glucose tolerance (Boucher 1998, Mathieu et al 2005). Scragg et al 2004 showed that risk of type 2 diabetes increases in White and Mexican adults, but not in black adults, in the United States as vitamin D declines. The mechanism suggested was that vitamin D deficiency results in hyperparathyroidism through which it may influence glucose metabolism. Skeletal muscle a key component of the insulin resistance syndrome may also be involved since vitamin D receptors have been identified in that tissue. Lack of association with non-Hispanic blacks may reflect threshold effects that varies with ethnicity. They may have decreased sensitivity to the effects of vitamin D or related hormone, PTH.A recent study in 753 postmenopausal women attending a university outpatient clinic in Australia found an inverse association between fasting plasma glucose and serum 25-hydroxyvitamin D while controlling for age and BMI. (Need et al 2005).Chiu et al 2004 evaluated the association between serum 25-hydroxyvitamin D concentrations and insulin sensitivity and beta cell function assessed by the 3 hour hyperglycemic clamp technique in 126 healthy, glucose tolerant subjects, and found a positive correlation between 25-hydroxyvitamin D and insulin sensitivity index. They also observed that subjects with hypovitaminosis D (defined as plasma 25-hydroxyvitamin D levels lower than 20ng/ml) had a significantly higher risk for components of the metabolic syndrome than did subjects without hypovitaminosis D. Hyponenn et al 2006 evaluated the interrelationship between vitamin D status, body size, and glucose homeostasis, measured by HbA_{1c}. The result suggested that vitamin D may influence glucose metabolism and this association may depend on body size. Cigolini et al 2006 found a high prevalence of hypovitaminosis D and a strong inverse association between 25(OH) D concentrations and prevalent type 2 diabeties in outpatients. Result suggested that low vitamin D status results in elevation of parathyroid hormone which has been linked to insulin resistance and significant increase in serum levels of many acute phase proteins and thus act as a risk factor for CVD. Circumstantial support for an association between vitamin D and insulin functions in humans is provided by the observation that the vitamin D receptor Fok 1 polymorphism in the translation initiation codon is associated with insulin sensitivity. (Chiu et al 2001)

Supporting results from Vitamin D Intervention trials

The restoration of vitamin D reserves in vitamin D deficient patients has been shown to improve glucose tolerance. Some studies have shown that supplementation with Vitamin D reduces the concentration of serum free fatty acids in patients with type 2 diabetes. (Inomata et al 1986).Pittas et al 2006 found that women who consumed 800IU/day or more of total vitamin D had 23% lower risk for development of incident diabetes than women who consumed less than 200IU/day.Women who consumed $\geq$ 400IU/day vitamin D from supplements compared with women who consumed $\leq$ 100IU/day had 13% lower risk of diabetes. Mechanisms by which vitamin D may affect the risk of type 2 diabetes are not clear. Both insulin resistance and

impaired pancreatic beta cell function have been reported with vitamin D insufficiency Studies on the administration of Vitamin D supplements or even higher doses of, $25(OH)_2 D_3$ to vitamin D sufficient patients with IGT or type 2 diabetes have yielded conflicting results. Vitamin D supplementation improved first phase insulin secretion in type 2 diabetic patients. (Borrisova et al, 2003). Extrapolating from the data of Chiu et al 2004 the authors suggested that an increase in plasma 25-hydroxyvitamin D from 10-30ng/ml could improve insulin sensitivity by 60%. However further research is needed to confirm the finding and to determine possible mechanism of any preventive effect of vitamin D supplementation against diabetes.

VITAMIN D & HYPERTENSION:-

Hypertension is well recognized as a feature of hyperparathyroidism. The secondary hyperparathyroidism may therefore contribute to the production of glucose intolerance and hypertension and to progressive deterioration once diabetes has established. Vitamin D may regulate blood pressure by regulating the rennin angiotensin system (Li YC 2005). Vitamin D receptor knock out mice have elevated blood pressure and plasma rennin activity (Li et al 2002). In humans there is a negative relationship between serum 1-25dihydroxyvitamin D levels and plasma rennin activity (Resnick et al 1986). Vitamin D acts as a negative endocrine regulator of the rennin angiotensin system by decreasing the expression of rennin in the kidney (Li et al 2002) (Fig 3). A study found a linear correlation between the rise in blood pressure or the prevalence of hypertension and latitude north or south of the equator, indicating a possible relationship between UVB irradiation, cutaneous vitamin D synthesis and blood pressure (Rostand et al 1997). Studies examining Vitamin D intake and blood pressure in humans reported conflicting results. Jorde Rolf et al 2000 ,in a large study including 15,000 Norwegian men and women,25-69 years of age,assessed vitamin D intake from food frequency questionnaire and found no association with blood pressure after multivariate adjustment for age, BMI, alcohol, caffeine, physical activity and smoking. Foman et al 2005 recently evaluated dietary vitamin D intake and risk of hypertension from three, large prospective cohort studies, comprising over 200,000 participants from the Nurses health Studies and the health professionals, but found no relationship. Scragg et al 2007 recently analyzed the association between serum 25(OH) D and blood pressure in 12,644 people aged $\geq$20 years from NHANES III. Serum 25(OH) D was lowest in non Hispanic backs (49nmol/l), intermediate in Mexican American (68nmol/l) and highest in non Hispanic whites (79nmol/l). Systolic& diastolic blood pressure was lower for participants in the highest quintile (Serum 25(OH) D $\geq$ 85.7 nmol/L) compared with lowest quintile (Serum 25(OH) D $\geq$ 85.7 nmol/L) after adjusting for age, sex, ethnicity and physical activity. Thus vitamin D was inversely associated with blood pressure in a large representative sample of the US population.

Supporting results from Vitamin D Intervention trials

Some but not all intervention studies have demonstrated blood pressure lowering effects. Scragg et al 1995 showed that daily administration of 5 ug vitamin D in 189 normotensive subjects for 8 weeks had no effects on blood pressure. To better elucidate the effect of vitamin in hypertension, Krause et al 1998 exposed a group of hypertensive adults to a tanning bed that emitted UVA and UVB radiation similar to summer sunlight 3 times a week during three months. A control group was submitted to a tanning bed that only emitted UVA light similar to winter sunlight and no UVB radiation. They observed a significant increase in circulating 25-hydroxyvitamin D levels

and a decrease in systolic and diastolic blood pressure in the group submitted to the UVA/UVB tanning bed treatment. The authors suggest that the effect may be mediated by concomitant changes in calcium regulating hormones. In a study by Pfeifer et al 2001 an 8 week supplementation of vitamin D in elderly women with low serum 25(OH) D found a 72% increase in serum 25(OH) D and a decreased systolic pressure. The effect was most likely due to the restoration of parathyroid gland function to normal. However given the importance of sun exposure and other factors in addition to dietary Vitamin D intake as determinants of vitamin D status, it is unclear whether apparent differences in vitamin D intake accurately reflected important differences in vitamin D status, particularly the ability to identify individuals with suboptimal vitamin D status, who would be most likely to manifest any hypertensive effects associated with vitamin D status. Thus, considering the potential limitation of the studies, future prospective studies investigating biomarkers of vitamin D insufficiency and the risk of incident hypertension are needed.

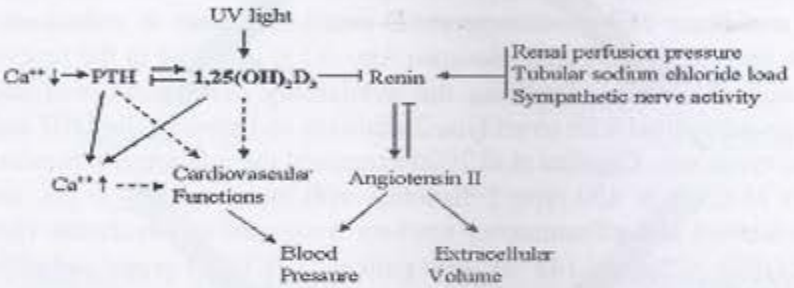

Fig 3:- Interaction between Vitamin D endocrine system and rennin-angiotensin system: "Vitamin D and rennin angiotensin system"; Retrived on 19th February 2008 from in.images.serach.yahoo.com

VITAMIN D & DYSLIPIDEMIA, PRO-INFLAMMATORY AND PRO-THROMBOTIC STATES: -

Dyslipidemia, pro-inflammatory state and pro-thrombotic state are components of metabolic syndrome. Lack of calcitriol results in an increase in serum PTH. Excess PTH levels may at least in part promote CVD by an increased cardiac contractility, chronic atherosclerosis via insulin resistance, Ca and phosphate deposition in vessel walls and chronic myocardial calcification. (Rostand & Dreuke 1999).An increase in serum C-reactive protein levels is an important indicator of inflammatory reactions and also of the risk of developing CVD (Val Lente et al 2000). Experimental studies have shown that calcitriol dose dependently suppresses the release of pro-inflammatory cytokine TNF- alpha and IL-6. (Muller et al 1992).Low 25(OH)D influences the activity/ expression of lymphocytes and macrophages in atherosclerotic plaques, thus promoting chronic inflammation in the artery wall(Cigolini et al 2006).In contrast to its effect on pro-inflammatory cytokines,calcitriol up regulates the synthesis of anti-inflammatory cytokine IL-10(Canning et al 2001) Studies have shown that vitamin D results in improvement of systemic inflammation as vitamin D interacts with vitamin D response elements in the promoter region of cytokine genes to interfere with nuclear transcription, factors implicated in cytokine generation and action (Riachy R et al 2002, Gysemans CA et al 2005, & Van Etten E et al 2005). It has been

shown to protect against cytokine-induced apoptosis that may occur after a rise in cytosolic free Ca (Christakos S et al 2003).

Hyovitaminosis D has been associated with increased total serum cholesterol. (Fig 4) .Grimes et al 1996 investigated the relationship between geography and incidence of coronary heart disease. Both vitamin D and cholesterol are derived from squalene. Although photo-metabolite involvement of cholesterol may occur in other ways, it is possible that where as in the presence of sunlight, squalene in exposed skin is converted to 7-dehydorcholesterol and vitamin D, i the absence of sunlight its metabolic pathway is diverted into formation of cholesterol. Thus, sunlight influences susceptibility to number of chronic disease. 1, 25-(OH) 2 D3 suppresses apo A1 gene expression at the transcriptional level. (Wehmeier et al, 2005). John WG et al 2005 determined the relation of circulating 25(OH) D concentrations to fasting lipids concentration in South Asian Subjects at risk of hypovitaminosis. The contribution of hypovitaminosis D to dylsipidemia did not appear to extend beyond an effect of Apo-A1 concentration. The finding supported the postulate that avoidance of hypovitaminosis D could contribute to reductions in the risk of the sequelae of the metabolic syndrome. Because Apo-A1 is involved in the reverse transport system that clears tissue cholesterol, lowering the availability of Apo-A1 will increase the risk of vascular damage associated with overt type 2-diabetes and specifically IHD and stroke associated with metabolic syndrome. Cigolini et al 2006 examined the relationship between serum 25(OH)D and prevalence of CVD in 459 type 2 diabetics with mean age 61$\pm$6 yrs, serum 25OHD were measured. Cholesterol and inflammatory markers were used as covariates. Hypovitaminosis was defined as 25OHD <20ng/ml.143 of 459 patients (31.1 %) were coded positive for CVD. Prevalence of CVD was greater among those with hypovitaminosis D. There was an increase in CRP levels among those with hypovitaminosis D. The author suggested that elevated CVD risk associated with hypovitaminosis D was probably mediated by correlated elevations in plasma inflammatory markers. The result suggested that low vitamin D status results in elevation of parathyroid hormone which has been linked to insulin resistance and significant increase in serum levels of many acute phase proteins and thus acts as a risk factor for CVD. Low 25(OH) D influences the activity/ expression of lymphocytes and macrophages in atherosclerotic plaques, thus promoting chronic inflammation in the artery wall. Low vitamin D also increases the PTH, which leads to insulin resistance and also increase in the serum levels of many acute phase proteins. This explains how hypovitaminosis D might act as a risk factor for CVD.

Intervention trials with vitamin D:-

Genevieve et al 2007 determined the effects of daily Ca intake and of supplementation with Ca + Vit D during a weight loss intervention on BP, plasma lipid, lipoprotein concentration and glucose & insulin concentration in healthy, overweight, obese women (n=63) who were randomly assigned in a double blind manner to 1 of 2 groups: group consuming tablets (600mg elemental Ca+200IU vit D)/day or the group receiving placebo with 700kcal/d energy restriction and completion of 15 wks weight loss intervention. There was significant greater decrease in Total: LDL C, LDL: HDL & LDL in the Ca and Vit D group compared to placebo group. The beneficial effect of vitamin D on apo-lipoprotein gene expression and cholesterol is still controversial. Schleithoff et al 2006 determined the effect of Vitamin D supplementation on the survival rate and different biochemical variables in patients with CHF. 123 patients randomly received 50ug Vit D/d+500mg Ca/D or placebo plus 500mg Ca/day for 9 months. The result showed that

supplementation of vitamin D is able to increase serum concentrations of the Anti-inflammatory cytokine IL-10 and to prevent an increase in serum concentrations of pro-inflammatory cytokines TNF-alpha in CHF patients. It also suppresses the concentration of PTH that contributes to impaired cardiac function. Thus vitamin D can serve as an anti-inflammatory agent and may therefore be useful for the management of CHF. Further investigation is necessary to evaluate whether hypovitaminosis D is associated with incident CVD among type 2 diabetic adults and to determine possible mechanism of any preventive effect of vitamin D supplementation against CVD. The optimal vitamin D intake for CVD is currently unknown but 2000-4000 IU is suggested (Zitterman et al 2006)

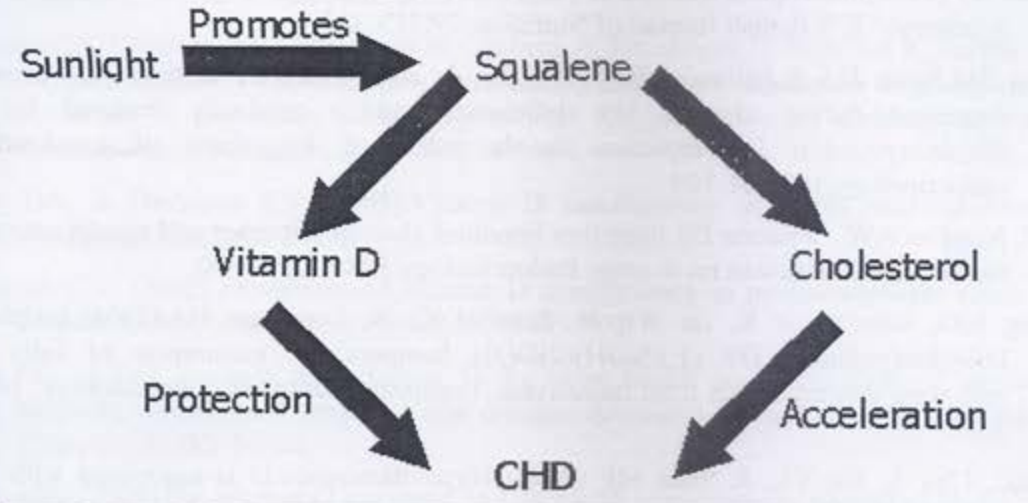

Fig 4:-Vitamin D and CHD

Grimes DS, Hindle E, & Dyer T. (1996) Sunlight, cholesterol and coronary heart disease. Quarterly Journal of Medicine; 89:579-589

CONCLUSION

Increasing awareness of the prevalent nature of the metabolic syndrome and the rising number of cases of type2 diabetes in the wake of the "obesity epidemic" has focused increasing attention on the identification of potentially modifiable risk factors. Poor vitamin D status has been connected with suboptimal insulin responsiveness in both animal and human studies. Vitamin D insufficiency and deficiency are common in some population groups. Additional scientific scrutiny of the role of Vitamin D status on insulin sensitivity and glucose homeostasis and the possible benefits of increased Vitamin D intake in various populations seems warranted. The expert group of ICMR has not recommended dietary intake of vitamin D for Indians. (Harinarayan et al, 2004). The observation suggests that new guidelines for vitamin D should be recommended. This will have important public implication because this intervention can be implemented easily and inexpensively.

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INFLUENCE OF AGE ON MATERNAL NUTRITIONAL STATUS AND PREGNANCY OUTCOME

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The present investigation was carried out to assess the influence of maternal age on nutritional status and pregnancy outcome. The mothers were followed up right from conception till delivery. Anthropometrics measurements were taken using standard procedures. Dietary intake was calculated based on 24 hrs dietary recall method. The body mass index (BMI) of subjects in the age range 16-20 years was lower than older age groups. More number of subjects belonging to the younger age group (16-20 years) had a low protein and fat status as depicted by MUAC, MUAMC and TSF values. Incidence of Low birth weight (LBW) and shorter babies (< CHL) were found to be higher among the younger age group mothers (67.6%). Caesarean deliveries were higher among women above 30 years. The study thus indicated that adverse pregnancy outcomes were greater both with mother's < 20 years and >30 years of age.

Maternal health and nutrition are important for the survival and well being of women and are the key determinants of health and well being of the fetus. Poor maternal nutrition has been shown to be one of the major determinants of intra uterine growth retardation (IUGR) in both developed and developing countries. Newborns who are small for gestational age (SGA) are at increased risk for long term adverse health outcomes such as hypertension, obesity, glucose intolerance and cardiovascular disease (Barker,1994).

Reproductive function in a female has a short period of optimal efficiency; a woman is obstetrically old before she is chronologically old. In India, most of the women complete their life families before first half of their twenties (Sambit et al., 1992). Too early or too late i.e., teenage pregnancies as well as pregnancy after 30 years have been associated with adverse pregnancy outcome (Jane et al.,2005).Teenage pregnancy is considered as high risk as it has not only health implications but also social, psychological and economical repercussions. On the contrary, an increasing number of women have elected to delay pregnancy. The trend towards delayed child bearing most likely reflects women's increasing interest in the pursuit of education and professional goals. Although, a large body of literature exists describing the impact of advanced maternal age on maternal and fetal outcomes, the data are conflicting.

Hence, the present investigation was carried out to assess the influence of maternal age on their nutritional status during pregnancy and on the pregnancy outcome among a sample of women from urban Bangalore.

METHODOLOGY

The study was carried out at four hospitals of Bangalore city (n=350). The four hospitals were selected so as to include both private and government hospitals. The hospitals included were

- MS Ramaiah Medical Teaching Hospital
- MS Ramaiah Super specialty Hospital
- KC General Hospital
- Arunodaya Clinic

The study group included 51 women aged between 16-20 years, 149 women between 21-25years, 112 women between 26-30 years and 38 women between 30-35 years. The women were selected based on their willingness to participate in this study as it was a longitudinal study (conception till delivery). The survey was conducted over a period of 4 years.

Anthropometric measurements such as height, weight, mid arm circumference (MUAC) and triceps skin fold thickness (TSF) were taken using standard procedures (Jellieffe, 1966). All the measurements were taken during their first or second ANC visit after confirmation of pregnancy and within 8 weeks. This time frame was chosen because there is enough evidence to indicate that pregnant women start gaining weight only after 8 weeks (Dutta, 1990: Aarti Malik, 2001). Dietary intake was calculated based on 24 hours dietary recall method, taken 3 times (I, II and III trimesters) during pregnancy. Mode of delivery, gestation week, Apgar scoring were noted from hospital records. Assessment of the clinical condition of the newborn baby at 1&5 min interval after delivery is termed as APGAR scoring. Apgar score <5 at 1 min & <7 at 5 min are considered as abnormal and such infants more often require neonatal intensive care. Birth weights of the neonates were taken within 24 hrs after birth. Crown heel lengths (CHL) of the neonates were also taken using standard procedures within 24 hours after birth.

The mid point of normal BMI was taken into account to derive the ideal body weight of the study group. Ideal body weight was calculated as $(Ht)^2$ m x 22.5. Recommended dietary intake of macro and micro nutrients were calculated based on ICMR Allowances (RDA) for age, sex, and activity (Gopalan et al.,1996). RDI of energy and proteins were calculated, based on the ideal body weight using the following formulae

i.e. Energy -38 Kcal. /kg body weight+ additional allowances (300 k cal.)
Protein--1 g/kg body weight+ additional allowances (15 g)

The food intake data of the women was used to estimate the dietary intake of energy and other nutrients. Food consumed by each woman was converted to its raw weight i.e. breaking up the menu items into its basic raw ingredients and assigning them into different food groups like cereals, pulses, vegetables, milk & milk products, meat, egg, fruits, fats & oils, sugar & jaggery (ICMR 1990). Food group intake data was translated into energy and other nutrients-macro (carbohydrate, protein, fat) and micronutrients (Calcium, Iron, Retinol, Ascorbic acid, B-complex vitamins-Thiamine, Riboflavin and Niacin) by using food composition tables. (Gopalan et al.,1996). No adjustments were made to correct the losses of vitamins on account of storage and preparations, while translating the food intake into nutrients. The nutrient intake of the women was compared against recommended dietary intake (RDI).

The RDI of the individual was also used to derive a desirable dietary pattern (DDP) by translating the RDI into foods in amounts desirable to ensure nutritional adequacy in terms of macronutrients. The DDP was derived as given below based on the RDA for adults with respect to energy &protein.

a) Identifying the source of carbohydrate major (cereals& pulses) and minor (sugar, fruits& vegetables).
b) Calculating the amount of sugar as equivalent to 3-4 tea spoons (i.e. used for 2 cups of coffee/tea) per day-approximately 20-30 grams.
c) Approximately an amount of 70 grams of total carbohydrates was derived from sugar, fruits and vegetables (30+10+30) respectively. This amount was subtracted from the total carbohydrates.
d) The amount of cereals & pulses was calculated on the basis of the remainder total carbohydrates in the ratio of 7:1.

e) The amount of protein from cereals and pulses (as per the amount fixed in the earlier step) was calculated and the remainder was made up with the milk & milk products. (In a vegetarian diet at least 5% of the recommended protein has to be from the animal sources amounting to about 200-250 ml of the milk in a diet containing 50 grams of protein)
f) The total amount of fat was derived by summing up the total fat (invisible) content of the foods already listed.
g) The total fat in the DDP was derived by subtracting the invisible fat from the total. The resulting amount was provided in the form of fats &oils (visible).

The food intake data was then compared with the DDP.

Suitable statistical tests were employed to derive significance of results.

RESULTS & DISCUSSION

It was observed that majority of the families (51%) belonged to nuclear type while 48% belonged to joint families. The level of education varied widely among the subjects. More number of subjects had studied < SSLC level (29%). Majority of the subjects were house wives (79.1%), only 21% of the subjects were employed in various capacities i.e. clerical, technical, teaching, medical profession and business. The estimated mean monthly income from different sources ranged from Rs.2000/- to >10,000/- with most of them (31%) falling in the income range of >Rs.10,000/- per month, indicating a general higher economical status among subjects in the study.

An appraisal of physiological events, affecting the reproductive performance viz-a-viz age at menarche, age at marriage was established and compared to the acceptable range generally observed among women in India. Majority of the subjects in the study (49.7%) had attained menarche between 13-14 years and between 15-16 years (27.2%) indicating a higher mean age at menarche for subjects of the study. Age at marriage ranged between < 19 to 30 years, majority of them being married between 19-25 years. Among the subjects, 62% were primigravidae and only 6% were multipara with four and more pregnancies.

Somatic Status: The body size of adults is widely used as an indicator of overall health and nutritional status of a community. Majority of subjects (61.1%) had normal BMI values (Table 1). This is probably because of the fact that the subjects were < 40 yrs old. It has long been recognized that in adult life with advancing age, body weights tend to rise due to change in body composition. The BMI of subjects in the age range 16-20 years was lower compared to those in the higher age-group (31-35 years). Lower BMI was more among 16-20 y old age group (29%) as compared to the higher age groups. The influence of age on BMI was statistically significant at 5% level.

Table 1: Classification of subjects by BMI and age groups

Age Groups (years)	BMI classification								X^2 Value
	<18.5		18.5-20.0		>25.0		Total		
	n	%	n	%	n	%	n	%	
16-20	15	29.4	31	60.8	5	9.8	51	100	29.13*
21-25	36	24.2	92	61.7	21	14.1	149	100	
26-30	14	12.5	70	62.5	28	25.0	112	100	
31-35	1	2.6	21	55.3	16	42.1	38	100	
Combined	66	18.9	214	61.1	70	20.0	350	100	

* Significant at 5 % level

Maternal weight gain during pregnancy is a predictor of infant birth weight. Studies have reported that the mean birth weight of newborns increases with increase in the age of their mothers upto 30

years (Mridula et al., 2002 & George et al., 2003).The desirable weight gain during pregnancy is 10-12 kgs (ICMR,1990). Table 2 presents the body weights of the subjects' grouped age wise. The mean initial body weight, final weight and gain in weight were higher among the age 30+ and lower among the women belonging to the age group 16-20years. The weight gain differed significantly among the age-groups ($p<0.05$). The results of the present study indicate that the weight gain was higher among women of 30+ age group indicating a better gestational performance. However, the initial weights of these groups were also higher indicating their well being and good nutritional status from pre-conception.

Table 2: Gain in weight during pregnancy among subjects of different age groups

Age Groups (years)	Sample (n)	Weight (kg)			Paired t-test
		Initial weight	Weight at term	Gain in weight	
		Mean ± SD	Mean ± SD	Mean ± SD	
16-20	48	45.51 ± 7.9	55.17 ± 10.6	10.35 ± 2.1	34.15*
21-25	146	49.90 ± 9.5	60.76 ± 10.7	10.95 ± 3.1	44.10*
26-30	108	54.73 ± 9.9	65.40 ± 11.2	10.90 ± 2.8	40.46*
30+	37	57.37 ± 8.5	70.03 ± 9.4	12.27 ± 3.1	24.08*
Combined	339	51.62 ± 8.8	62.46 ± 10.4	10.99 ± 2.8	72.26*
F-test		17.98*	17.43*	3.25*	

* Significant at 5 % level, n = 11 cases are aborted

More number of subjects belonging to younger age-group (16-20 years) had a low protein and fat status as depicted by MUAC, MUAMC and TSF values. A better protein status was observed among majority of 30+ age-groups as shown by MUAC (87%) and MUAMC (89%). However 60% of the subjects showed low fat status (Table 3). The difference between the age groups were statistically significant ($p<0.05$).

Table 3. Percentile classification of age groups on MUAC, MUAMC and TSF measurements

Percentile of Std	Age groups (years)				Combined
	16-20	21-25	26-30	30+	
MUAC					
>100	1 (2.0)	22 (14.8)	32 (28.6)	17 (44.7)	72 (20.6)
90-100	12 (23.5)	47 (31.5)	41 (36.6)	16 (42.1)	116 (33.1)
80-89	23 (45.1)	53 (35.6)	30 (26.8)	4 (10.5)	110 (31.4)
70-79	15 (29.4)	27 (18.1)	9 (26.8)	1 (2.6)	52 (14.9)
X^2=57.9*					
MUAMC					
>100	3 (5.9)	30 (20.1)	46 (41.1)	23 (60.5)	102 (29.1)
90-100	24 (47.1)	52 (34.9)	37 (33.0)	11 (29.0)	124 (35.4)
80-89	20 (39.2)	63 (42.3)	26 (23.2)	4 (10.5)	113 (32.3)
70-79	4 (7.8)	4 (2.7)	3 (2.7)	0 (0.0)	11 (3.1)
X^2=53.3*					
TSF					
>100	0 (0.0)	9 (6.0)	8 (7.1)	6 (15.8)	23 (6.6)
90-100	8 (15.7)	12 (8.0)	21 (18.8)	9 (23.7)	50 (14.3)
80-89	1 (2.0)	25 (16.8)	31 (27.7)	8 (21.1)	65 (18.6)
70-79	4 (7.8)	27 (18.1)	19 (17.0)	5 (13.2)	55 (15.7)
<70	38 (74.5)	76 (51.0)	33 (29.5)	10 (26.3)	157 (44.9)
X^2=52.8*					

* Significant at 5 % level

Dietary Intake: Average intake of different food items by the subjects is given in Table 4. Except pulses, all other food items consumed by the pregnant women fell short of required amounts. However, the intake was found to be very less among 16-20 years compared to the higher age groups.

Table 4: Mean Food consumption of subjects of different age group in comparison with DDP

Food Items (gm)	Age groups (years)				
	16-20	21-25	26-30	30+	DDP#
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean
Cereals	257 ± 51	293 ± 74	282 ± 57	270 ± 50	390
Legumes	41 ± 15	71 ± 26	75 ± 27	78 ± 20	73
Roots &Tubers	24 ± 14	30 ±18	32 ± 13	21 ±11	50
Other vegetables	77 ± 21	80 ± 24	78 ± 20	90 ± 26	100
Green leafy vegetables	29 ± 22	39 ±19	31 ±16	29 ±16	100
Fruits &dry fruits	41 ± 23	67 ± 25	57 ± 20	67 ± 28	100
Sugar	12 ±5	12 ± 6	16 ± 6	13 ±5	30
Milk &milk products	138 ± 30	190 ± 37	190 ± 47	228 ± 66	250
Fats	14 ± 5	20 ±7	20 ± 8	19 ± 4	35
Flesh foods	11 ± 10	8 ± 5	12 ± 6	13 ± 7	NA

DDP: Desirable Dietary Pattern, computed based on RDA for adult women with ideal body weight, NA: Not applicable

The lower intake of food was also reflected in the deficient intake of most of the nutrients. Though the pulse intake was better, it failed to meet the protein and fat intake of these subjects. Thus, all the subjects failed to meet the recommended levels of ICMR for Indians with respect to macro & micro nutrients. By and large subjects of 21-25 years and 26-30 years showed a better nutrient intake compared to other groups (Table 5 & 6). Based on dietary data, 21-30 years appears to be the prime and right age for conception. However, it is also possible that majority of the women belonging to this age group in the study population may also have been from the higher economic group.

Table 5: Mean intake of macro nutrients of subjects in comparison with RDI#

(-different age group subjects)

Age Groups (Yrs)	Sample (n)	Energy(K cal)		Protein (g)		Fat (g)		CHO (g)		Fiber(g)
		Intake	RDI	Intake	RDI	Intake	RDI	Intake	RDI	
16-20	51	1367± 538	2283± 159	37.2± 16.3	57.1± 4.0	30.2± 5.7	50.7± 3.5	235± 102	400± 27.8	8.4±4.0
21-25	149	1568± 655	2347± 177	44.9± 19.3	58.7± 4.4	39.1± 10.5	52.2± 3.9	257± 112	411± 31.0	9.1±3.7
26-30	112	1563± 553	2359± 162	46.8± 16.6	59.0± 4.0	41.5± 9.8	52.4± 3.6	252± 102	413± 28.3	8.9±3.3
30+	38	1547± 654	2355± 154	45.9± 215	58.9± 3.9	39.6± 12.4	52.3± 3.4	251± 118	412± 27.0	8.3±3.5

Recommended Dietary Intake-RDI

Table 6: Mean micro nutrient intake of subjects - different age groups

Age Groups (years)	Sample (n)	Micronutrients			
		Calcium (mg)	Iron (mg)	Carotene (µg)	Vitamin C (mg)
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
16-20	51	391±258	16.9±10.3	1090±2070	12.1±20
21-25	149	542±269	19.8±8.4	2145±2739	30.8±35
26-30	112	476±308	17.0±8.0	2111±3289	17.5±24
30+	38	467±279	17.5±8.3	2162±3136	26.7±26
Combined	350	474±272	17.6±8.2	1948±2921	23.3±28
RDA*		1000	37.5	2400	40

RDA*: Recommended Dietary Allowance

The findings of the research reports of several groups of workers have also indicated that the diet of pregnant women is inadequate both in quality and quantity (Reddy et al., 1994). The present study also depicts similar results.

Outcome of delivery: In the present study, the perinatal outcome was assessed in relation to maternal age.

Table 7: Out come of delivery among subjects of different age groups

Out come of pregnancy	Age groups (years)										
	16-20		21-25		26-30		30+		Combined		X^2
	n	%	n	%	n	%	n	%	n	%	
Birth wt (kg)											
<2.75	23	67.6	38	35.5	33	42.3	13	37.1	107	42.1	11.36*
>2.75	11	32.4	69	64.5	45	57.7	22	62.9	147	57.9	
CHL											
< 48.0 cm	25	73.5	53	49.5	48	61.5	15	42.9	141	55.5	9.44 *
> 48.0 cm	9	26.5	54	50.5	30	38.5	20	57.1	113	44.5	
Gestation (wk)											
32-34	6	17.7	15	13.9	10	12.7	5	14.7	36	14.1	4.23^{NS}
35-37	13	38.2	55	50.9	36	45.6	20	58.8	124	48.6	
38-41	15	44.1	38	35.2	33	41.8	9	26.5	95	37.3	
Mode of delivery											
Caesarian	6	17.7	42	38.9	33	41.8	17	48.6	98	38.3	8.95^{NS}
Induced labor	8	23.5	14	13.0	12	15.2	4	11.4	38	14.8	
Normal	20	58.8	52	48.2	34	43.0	14	40.0	120	46.9	

* Significant at 5 % level

Low birth weight (LBW) and shorter babies (< CHL) cases were found to be high among younger age-group (67.6%).The difference between the groups for birth weight and CHL measurements was also found to be statistically significant ($p<0.05$). Younger mothers in our study were also thinner as reflected by their low BMI, low diet intake and lower weight gain during pregnancy. Our findings are in agreement with the results of earlier reports on perinatal outcome and maternal age (Nerlekar et al.,1999, Pallavi & Usha, 2002, Goerge et al., 2003). Age at marriage which is mostly determined by socio-economic status decides the age of pregnancy. Here the involvement of health care system becomes less predominant. The preterm deliveries as indicated by gestation week, was also greater among younger age-group (17.7%). However, the cesarean deliveries were higher among women above 30 years (Table 7). Many studies have observed that the risk of cesarean delivery increases with greater maternal age (Sambit et al., 1992: Frank et al., 1995: Angela 1996: Jeffrey et al., 2001: Jane et al., 2005)

CONCLUSION

The study reiterated the fact that adverse pregnancy outcome are greater with mothers < 20 years and > 30 years old. Raising the legal age of marriage in India to 18 years was an important step and has made some impact on reducing the young age pregnancies. However, educating the girls may be a primary preventive measure. Obstetrically, a woman giving birth in the 3rd and 4th decade of her life should not fare well.. But in the present study, compared to teenage group (16-20y), the outcome was better in women of more than 30 y age group. Hence, although the likelihood of adverse outcomes increases along with maternal age, patients and obstetric care providers can be reassured that overall maternal and foetal outcomes are favourable in this patient population.

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DIETARY HABITS, MEAL PATTERNS AND FOOD CHOICES OF ADOLESCENTS WITH SPECIAL EMPHASIS ON CALCIUM INTAKE AND IMPACT OF NUTRITION EDUCATION

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Adolescence is one of the most challenging periods in human development. Osteoporosis, which is associated with low calcium intake, has been called the "Pediatric disease with geriatric consequences". Obtaining sufficient calcium during youth contributes to adequate mineralization of the skeleton and achievement of peak bone mass to ensure healthy bones in later life. Hence the present study is designed to identify dietary pattern and food choices among adolescents and to study the impact of a nutrition education programme on the nutrition knowledge and awareness of adolescents. Data pertaining more specifically to intakes of calcium rich foods has been presented in this paper. A nutrition education program was formulated and conducted to create awareness on the importance of calcium consumption among adolescents. The study concludes that adolescent girls skip breakfast and consume deep fried food and aerated drinks more frequently than boys. A greater percent of girls consume calcium supplements compared to boys. Frequency of food intake data revealed poor intakes of calcium rich sources in the diets of adolescents. There was a significant difference in the knowledge level of the adolescents before and after the nutrition education program.

Adequate dietary intake during adolescence is essential for optimal health in adulthood. Adequate dietary calcium intake during adolescence is important for the accretion of peak bone mass, which has been shown to protect against osteoporosis in later life(Larson et al, 2006). While peak bone mass is fully achieved during early adulthood, fractional calcium absorption is highest during early adolescence (Gao et al, 2006).

Failure to gain optimal bone minerals during adolescence contributes to low bone density, which is a major risk factor for developing osteoporosis among young people. Calcium intake may be an important modifiable factor related to attainment of peak bone mass (Carter et al, 2002). The role of calcium in the development of strong bones and teeth is well established. Calcium is also related to cardiovascular function, nerve conduction, muscle contraction as well as normal heart rhythm and blood clotting. Research indicates that calcium deficient diets are a risk factor for such diseases as pre-eclampsia, cardiovascular diseases, hypertension, cancer, and osteoporosis (Zemel et al, 2004).

As adolescence bridges the period between childhood and adulthood, nutritional assessment should be carried out during this period to find out their dietary intakes and nutritional status and to correct the deficiency in their diets. (Shils et al, 2006)

Research evidence shows that nutrition education programmes seem to have the potential to lead to a healthier lifestyle and thus reduce the risk factor levels for chronic disease conditions (Manios et al, 2002). By altering dietary behaviors, nutrition interventions during adolescence has

the potential of affecting intakes at that time as well as later on in life. Hence nutrition interventions find their immense importance in bringing about behavior changes (Hoelscher et al, 2002).

Hence the present study was designed to identify dietary patterns and food choices among adolescents with particular reference to calcium intakes and to study the impact of a nutrition education programme on the knowledge and awareness of adolescents in correcting faulty dietary habits.

MATERIALS AND METHODS

A randomized sampling technique was used to select 250 adolescent girls (125 girls from private institutions and 125 girls from government institutions) and 250 adolescent boys (125 boys from private institutions and 125 boys from government institutions) in the age range of 13 to 15 years. Ex-post facto approach was used to elicit information regarding the demographic data of the adolescents. A standardized questionnaire was used to study the dietary habits, meal pattern and food choices of the adolescents with special emphasis on calcium intake. The questionnaire comprised of questions on type of diet consumed, snacking pattern, and meal pattern, intake of calcium supplements and frequency of consumption of calcium rich foods.

From the 250 adolescent girls, a sub sample of 50 girls consisting of 25 girls who consume adequate amounts of calcium and 25 girls who consume inadequate amounts of calcium were selected at random in order to conduct a pre-post experimental design to ascertain the impact of a nutrition education program. The data collected during the study was consolidated and analyzed statistically.

RESULTS AND DISCUSSION

The dietary habits and food consumption pattern of the adolescents with special emphasis on calcium intake were studied and the results are presented. Table 1 presents percent distribution of adolescent boys and girls according to their dietary habit.

Table 1: Percent distribution of the adolescent boys and girls according to their dietary habits

Gender	Dietary habit	Institution	
		Private	Government
Boys	Vegan	4.8	0
	Lacto-vegetarian	4	0
	Lacto-ovo-vegetarian	6.4	36.8
	Non-vegetarian	85.6	63.2
Girls	Vegan	5.6	0
	Lacto-vegetarian	9.6	4.8
	Lacto-ovo-vegetarian	15.2	3.2
	Non-vegetarian	69.6	92

Majority of the adolescent boys and girls were non-vegetarians in the private as well as government institutions. About 5.6 per cent of adolescent girls and 4.8 per cent of adolescent

boys from private institutions were vegans i.e. totally avoid milk and milk products and were eating foods of plant origin only.

Concerns about body weight motivate some adolescence to adopt a vegetarian diet because it is a socially acceptable way to reduce dietary fat. Several vitamins, minerals and macronutrients may be deficient within vegan diet. A delayed growth spurt, calcium deficiency and vitamin B deficiency have developed in adolescents who have inadequate intakes of milk and milk products.

Meal pattern

Meal pattern, as used in this study, includes information on the consumption of breakfast, lunch and dinner, snacking pattern and intake of calcium supplements. More than 50 per cent of boys and girls from government institutions and 86.4 per cent of boys and 36.8 per cent of girls from private institutions did not consume their breakfast.

Large number of the breakfast skippers in the private institutes irrespective of the sex, consumed health drinks instead of breakfast. Fifty six per cent of boys from government institutions who did not consume their breakfast were in the habit of drinking tea/coffee instead of breakfast, while 6.4 per cent of the girls who did not consume their breakfast drank plain milk and health drinks instead. A small per cent of boys and girls from private institutions do not consume any thing for breakfast. Breakfast consumption by adolescents had declined over time; skipping breakfast prevents the adolescent from getting the recommended intakes of at least $1/3^{rd}$ calcium requirement essential for bone growth from the breakfast meal. The present study indicates that irrespective of the sex or type of institution where they study, majority of boys and girls consumed lunch packed from home (above 96 %).

Snacking pattern

Majority of adolescent boys (77 %) and girls (99%) consume chips and other deep fried items as their snack. Research shows that adolescents always consume commercial snacks especially salted chips more often than regular dessert (Areekul et al, 2005). Eighty per cent and sixty eight per cent of boys from private and government institutions respectively were in the habit of consuming aerated drinks as compared to 81 per cent and 99 per cent of girls from private and government institutions respectively.

Intake of calcium supplements

Results of the present study show that nearly half of the sample surveyed does not take calcium supplements. Calcium supplement usage was more predominantly seen in girls rather than boys and more in private than in government institutions. A variety of reasons were reported for taking these supplements including providing increased energy, decreasing stress and fatigue, reducing the risk for chronic disease and improving mental function. In terms of their overall nutrition, boys usually fair better than girls. They have larger appetite and the sheer volume of food consumed usually ensures an adequate intake of nutrients. On the other hand, girls who are under greater social pressure for thinness, restrict their food, have inadequate nutrient intake and therefore resort to nutritional supplements (Nix, 2005). The per cent distribution of adolescent boys and girls based on the intake of calcium supplements in given in Table 2

Table 2: Per cent distribution of adolescent boys and girls based on the intake of calcium supplements

Gender	Intake of calcium supplements	Institution (%)	
		Private N = 250	Government N = 250
Boys	Do not take	47.2	88.8
	Taking for < 3 months	24.8	2.4
	Taking for 3 – 6 months	16.0	8.8
	Taking for > 6 months	12.0	0
Girls	Do not take	60.0	94.4
	Taking for < 3 months	12.8	4.8
	Taking for 3 – 6 months	12.8	0
	Taking for > 6 months	14.4	0.8

Frequency of consumption of calcium rich foods

The frequency of consumption of selected calcium rich foods from each of the food groups was found out, the details of which are given below.

Ragi is one of the cheapest and richest sources of calcium in the daily diet. From Table 3 it is apparent that a majority of the adolescents do not consume ragi on a regular basis. Research findings, however, state that cereals in general are commonly consumed among most adolescents (Weaver, 2006). Recent literature states that inadequate consumption of whole grains and calcium sources, with excessive levels of fat, sodium and simple carbohydrates in the diet, results in low intake of key nutrients and a higher prevalence of overweight teens (Feskanich et al 2004).

Although pulses are not rich sources of calcium, whole grain legumes contribute sizable amounts of calcium to the diet. It is apparent from Table 3 that bengal gram whole is not consumed by a large group of the adolescents on a daily basis. The consumption of this pulse among the girls is comparatively lesser when compared to that of the boys. The consumption of green gram (whole) is very poor among the adolescents. It is usually consumed weekly once by boys and monthly once by girls (a notable percentage). Only a very small percent of the adolescent population consumes rajmah. A majority of them never or rarely consume it. Soya bean was being consumed by the adolescents from private institutions rather than government institutions. Recent research conducted by Rao et al., (2006), indicates that the mean intake of all the foodstuffs, especially the pulses, were lower than the recommended levels of ICMR for adolescents from the low socio-economic group.

The Table 3 presents the percent distribution of the adolescent boys and girls according to the frequency of consumption of selected cereals and pulses.

Table 3: Percent distribution of the adolescent boys and girls according to the frequency of consumption of cereals and pulses

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
I	**Cereal Grains**					
1	Ragi	Never/Rarely	50.4	16.8	56.8	46.4
		Monthly once	12.8	50.4	4.8	35.2
		Once in 15 days	5.6	6.4	0.8	0.8
		Once in a Week	27.2	18.4	28	15.2
		Daily	4	8	9.6	2.4
II	**Pulses and Legumes**					
1	Bengal Gram (Whole)	Never/Rarely	40.8	40.8	71.2	56.0
		Monthly once	7.2	7.2	18.4	16.0
		Once in 15 days	16	16	9.6	12.8
		Once in a Week	30.4	30.4	0.8	14.4
		Daily	5.6	5.6	0	0.8
2	Green Gram (Whole)	Never/Rarely	42.4	11.2	68.8	44
		Monthly once	10.4	24	18.4	31.2
		Once in 15 days	10.4	4.8	10.4	1.6
		Once in a Week	28	56	2.4	21.6
		Daily	8.8	0	0	1.6
3.	Rajmah	Never/Rarely	58.4	64	90.4	68.0
		Monthly once	10.4	4	8.0	25.6
		Once in 15 days	11.2	0.8	0.8	0.8
		Once in a Week	17.6	30.4	0	4.8
		Daily	2.4	0.8	0.8	0.8
4.	Soya bean	Never/Rarely	41.6	45.6	30.4	59.2
		Monthly once	16.8	21.6	23.2	7.2
		Once in 15 days	14.4	0.8	28.8	10.4
		Once in a Week	22.4	32	16.8	22.4
		Daily	4.8	0	0.8	0.8

The mean daily intake of pulses was grossly inadequate meeting only 36% of the suggested allowances of the adolescents(Malhotra and Passi, 2007) inspite of the health benefits of legumes.. A dietary pattern reflecting more health-conscious food choices such as high consumption of legumes was inversely, but less strongly associated with cardiovascular risk factors (Mikkila et al., 2007). Moreover, legumes being important sources of protein for vegetarian diets are important for bone health.

The percent distribution of the adolescent boys and girls according to the frequency of consumption of green leafy vegetables is presented in Table 4

Table 4: Percent distribution of the adolescent boys and girls according to the frequency of consumption of green leafy vegetables

S. No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
1	Agathi	Never/Rarely	43.2	44.8	71.2	44
		Monthly once	6.4	21.6	11.2	40
		Once in 15 days	24	22.4	9.6	1.6
		Once in a Week	20	11.2	8	14.4
		Daily	6.4	0	0	0
2	Amaranth	Never/Rarely	58.4	30.4	63.2	27.2
		Monthly once	8.8	20.8	30.4	29.6
		Once in 15 days	14.4	6.4	0.8	22.4
		Once in a Week	14.4	42.4	4.8	20.8
		Daily	4	0	0.8	0
3	Drumstick Leaves	Never/Rarely	31.2	24	60.2	44
		Monthly once	8	44	4.9	17.6
		Once in 15 days	14.4	16.8	19.5	5.6
		Once in a Week	34.4	8.8	15.4	17.6
		Daily	12	6.4	0	15.2
4.	Manathakkali Leaves	Never/Rarely	49.6	17.6	32.8	64
		Monthly once	8.8	68	10.4	20
		Once in 15 days	15.2	9.6	12	3.2
		Once in a Week	25.6	3.2	44	12.8
		Daily	0.8	1.6	0.8	0
5.	Ponnanganni	Never/Rarely	40.8	12.8	4	25.56
		Monthly once	12.8	40	20	34.4
		Once in 15 days	13.6	28	17.6	19.2
		Once in a Week	26.4	16.8	58.4	20.8
		Daily	6.4	2.4	0	0

Green leafy vegetables are a rich source of iron, calcium, and folate which is very essential for hemoglobin formation and bone growth and development of the adolescents. The requirements of these vitamins and minerals are also very high during this period. Hence the consumption of green leafy vegetables should be encouraged.

Results show that Agathi is rarely or never consumed by the adolescents. It is usually consumed on a weekly or monthly basis by the majority of the consumers and only by a negligible group on a daily basis. Agathi is known to be an excellent source of calcium. Amaranth is the commonly available green leafy vegetable in south India. Even this readily available greens is rarely consumed by a majority of the adolescents. Results have shown that boys tend to consume more drumstick leaves than the girls. Drumstick leaves are a very good source of iron which is very essential for adolescent girls. These are cheap and easily available.

Manathakali leaves are also found to rarely consume by a majority of the adolescents. A large number of the adolescents do not consume Ponnanganni on a daily basis but it is found to be consumed once in a week by a majority of the study population. Food frequency data of adolescent female factory workers in Bangladesh reveals that majority of the girls do not take dark green leafy vegetables although the frequency of intake of dark green leafy vegetables were significantly and independently related to serum vitamin A level (Ahmed et al., 1997).

Table 5 depicts the percent distribution of the adolescent boys and girls according to the frequency of consumption of other vegetables. Intake of vegetables that contribute more than 100mg% of calcium were looked into.

Table 5: Percentage distribution of the adolescent boys and girls according to the frequency of consumption of other vegetables

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Governmen t (n=125)
1	Field Beans	Never/Rarely	43.2	30.4	50.4	21.6
		Monthly once	4.8	14.4	10.4	14.4
		Once in 15 days	13.6	0	22.4	28.8
		Once in a Week	31.2	44	4	32.8
		Daily	7.2	11.2	12.8	2.4
2	Cho-Cho	Never/Rarely	58.4	44.8	70.4	48.8
		Monthly once	6.4	50.4	4.8	21.6
		Once in 15 days	11.2	0.8	21.6	22.4
		Once in a Week	24	4	3.2	5.6
		Daily	0	0	0	1.6
3	Cluster Beans	Never/Rarely	48.8	65.3	76	72
		Monthly once	6.4	26.6	20	11.2
		Once in 15 days	21.6	2.4	3.2	9.6
		Once in a Week	20.8	5.6	0.8	5.6
		Daily	2.4	0	0	1.6

From the above Table 5, it is clear that a majority of the adolescents did not prefer to consume any of the above mentioned vegetables on a regular basis. These results are in line with the prior findings that adolescents consume excessive amounts of fat (particularly saturated fat), sugar and salt and inadequate amounts of fruits and vegetables, whole grains, calcium - containing foods, and iron (Cavadini ,2000 ;Darmon et al, 2006).

Apart from contributing some calcium to the diet, vegetables are also a good source of fiber in the diet. The benefits of a high fiber diet cannot be undermined. Fiber reduces the chances of obesity, diabetes mellitus and cardiovascular diseases. Since the results show that vegetables were not consumed adequately by the adolescents, efforts should be taken to encourage adolescents to consume vegetables. Dietary habits inculcated in adolescence will help to develop good habits in adulthood.

Adolescence is a time when eating habits and health-related behaviours change and lead to the consumption of nutrient - poor, high - fat, high - energy foods (Hytle, 2002). In another study healthy-weight students consumed more "other vegetables" than students who were at risk of being overweight (Roseman, 2007). The percent distribution of the adolescent boys and girls according to the frequency of consumption of selected nuts and oilseeds (those that provide relatively more calcium) is given in Table 6.

Table 6: Percent distribution of the adolescent boys and girls according to the frequency of consumption of nuts and oilseeds

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
1	Almond	Never/Rarely	40.8	42.4	58.4	20.8
		Monthly once	14.4	24.8	14.4	46.4
		Once in 15 days	11.2	11.2	19.2	16.0
		Once in a Week	21.6	8.8	0.8	15.2
		Daily	12	12.8	7.2	1.6
2	Coconut (dry)	Never/Rarely	17.6	41.6	38.4	58.4
		Monthly once	12.8	29.6	4.8	20
		Once in 15 days	10.4	3.2	10.4	4
		Once in a Week	31.2	16	33.6	16
		Daily	28	9.6	12.8	1.6
3	Gingelly Seeds	Never/Rarely	67.2	60.8	98.4	76
		Monthly once	8	22.4	0.8	10.4
		Once in 15 days	3.2	8	0.8	11.2
		Once in a Week	16	8.8	0	0
		Daily	5.6	0	0	2.4

From the above Table 6, it is obvious that Gingelly seeds were consumed least by the study population of adolescents. Sesame seed allergy is becoming more common in childhood which could be a reason for its low consumption among adolescents (Agne et al, 2004).

Almonds were more commonly consumed by boys on a daily basis than the girls. Adolescents from private institutions consumed almonds more than those from government institutions in line with a previous research that food consumption varies by differences in socioeconomic, demographic, and lifestyle factors in young adults (Deshmukh-Taskar et al, 2007). Coconut (dry) was consumed by a majority of the adolescents and there were some who consume it on a daily basis also. Nuts and seeds are also important sources of omega 6 polyunsaturated fatty acids in the diet (Meyer et al, 2003). Frequent nut consumption is associated with lower rates of coronary artery disease (Sabate, 2003).Although condiments and spices are consumed in small quantities, regular consumption in the Indian cuisine can contribute sufficient micronutrients to the diet. With regard to condiments and spices, cumin seeds were the commonly consumed spice among the adolescent population and omum is the least preferred one. Condiments and spices are an important constituent of the Indian cookery. Poppy seeds and asofoetida were consumed by a few adolescents on a daily basis as an ingredient with other main dishes. These results are in

accordance with a recent study which revealed that the percentage of children consuming condiments significantly decreased in the past two decades (Nicklas, 2003).

Jaggery was preferred by a majority of the adolescent boys than girls and found to be a contributor to their total calcium intake.

By virtue of their dried nature, dry fruits contribute sufficient nutrients if consumed regularly. Table 7 presents data with regard to the frequency of consumption of common dry fruits by the adolescent boys and girls.

Table 7: Percent distribution of the adolescent boys and girls according to the frequency of consumption of dry fruits

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
1	Raisins	Never/Rarely	34.4	12.8	68	1.6
		Monthly once	4	11.2	4	26.4
		Once in 15 days	17.6	20	21.6	17.6
		Once in a Week	20	48	2.4	30.4
		Daily	24	8	4	24
2	Dates	Never/Rarely	20.8	2.4	20.8	20.8
		Monthly once	4.8	14.4	12.8	32
		Once in 15 days	19.2	42.4	19.2	6.4
		Once in a Week	28	25.6	4.8	37.6
		Daily	27.2	15.2	42.4	3.2

Dry fruits were found to be one of the major contributors of calcium in the diet of the adolescent population surveyed. Table 7 reveals that Raisins were consumed by 24 percent and 8 percent of the boys from private and government institutions respectively on a daily basis whereas 4 percent and 24 percent of the girls from private and government institutions respectively consume raisins daily. Dates were also found to be frequently consumed by a majority of the adolescents on a daily, fortnightly, monthly basis. Results of a recent study indicated that adolescents, especially females, were at risk for inadequate fruit and vegetable intake. Weight-control behaviours were high especially among females. Although some weight-control behaviours may be hazardous, adolescents who were practicing weight-control behaviours engaged in the positive dietary behaviour of consuming more servings of fruits and vegetables(Pesa and Turner, 2001). Other studies, however, indicate that the intake of fruits are below desirable levels among a majority of the adolescent population (Tur et al, 2004). Sea foods are important sources of calcium in the diet. Meat and poultry, contribute calcium if consumed in sizable quantities. The percent distribution of the adolescent boys and girls according to the frequency of consumption of sea foods, meat and poultry is given in Table 8.

Table 8: Percent distribution of the adolescent boys and girls according to thefrequency of consumption of sea foods and meat and poultry

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
1	Fish	Never/Rarely	26.4	20.8	29.6	9.6
		Monthly once	5.6	17.6	16.8	9.6
		Once in 15 days	16.8	20	22.4	27.2
		Once in a Week	48.8	41.6	31.2	42.4
		Daily	2.4	0	0	0
2	Dry Fish	Never/Rarely	43.2	26.4	64	44
		Monthly once	12.8	23.2	4	26.4
		Once in 15 days	11.2	8.8	0	7.2
		Once in a Week	31.2	33.6	32	22.4
		Daily	1.6	8	0	0
3.	Crab	Never/Rarely	49.6	40	36	51.2
		Monthly once	16	16	27.2	35.2
		Once in 15 days	10.4	12.8	24.8	4
		Once in a Week	24	31.2	12	9.6
		Daily	0	0	0	0
4.	Shrimp	Never/Rarely	72.8	75.2	90.4	84.8
		Monthly once	8	5.6	8	13.6
		Once in 15 days	8	3.2	0	0
		Once in a Week	9.6	14.4	1.6	1.6
		Daily	1.6	1.6	0	0
5.	Egg	Never/Rarely	12	10.4	17.6	6.4
		Monthly once	1.6	8.8	0.8	6.4
		Once in 15 days	10.4	0.8	28.8	32
		Once in a Week	38.4	68.8	31.2	39.2
		Daily	37.6	11.2	21.6	17.6
6.	Mutton	Never/Rarely	25.6	32.8	54.4	53.6
		Monthly once	3.2	12.8	10.4	7.2
		Once in 15 days	10.4	0	0.8	12.8
		Once in a Week	56	54.4	32.8	26.4
		Daily	4.8	0	1.6	0
7.	Beef	Never/Rarely	73.6	55.2	95.2	96.8
		Monthly once	7.2	13.6	2.4	0.8
		Once in 15 days	6.4	0.8	2.4	0
		Once in a Week	12.8	29.6	0	2.4
		Daily	0	0.8	0	0

Table 8, indicates that fish was the most commonly consumed sea food among the adolescents. A majority of them consume fish on a weekly basis. Fish is a rich source of n-3 polyunsaturated fatty acids that may confer multiple health benefits (Cohen et al, 2005). People with higher incomes ate significantly more fish meals than those with lower incomes (Burger et al, 2003). Dry fish and crab were also liked by a majority of the adolescent population and shrimp was the least preferred sea food among the adolescents. Studies suggest that traditional marine foods

remain very important to the social and economic well-being of adolescents (Mos et al, 2004). Since small dry fish are consumed with the bone, they are an excellent source of calcium.

It is evident from the table that, egg was most commonly consumed by a majority of the adolescents. Mutton was found to be consumed on a weekly or fortnightly or monthly basis by a large proportion of adolescent population. Beef was rarely or never consumed by most of the boys and girls. Changes occur in food group consumption patterns from childhood to young adulthood. Young adulthood consumption of meat and poultry was higher compared to that of childhood (Demory-Luce et al, 2004). Meat and poultry are also important sources of alpha-linolenic acid (LNA) in the diet which is an omega-3 fatty acid essential to maintain body functions (Meyer et al, 2003).

Milk and milk products are the best sources of calcium in diets. From Table 10, it is clear that plain or flavored milk was the most preferred milk product for a majority of the adolescents. Curd ranks next to milk. Panner, cheese and khoa were consumed on a weekly, fortnightly or monthly basis by a large number of the adolescents rather than on a daily basis. Ice cream was preferred by almost a majority of them.

Milk and milk products are important in the adolescents' diet, in order to provide abundant amounts of protein, vitamins, and minerals (Moore et al, 2004). Dairy products make important contributions to children's diet quality by providing abundant amounts of protein, vitamins and minerals. Dairy products are therefore nutrient-dense foods necessary to promote bone health, to help reduce risk for chronic diseases like osteoporosis, and to promote overall health. Inadequate calcium intake is a particularly important problem among adolescents who do not consume dairy products (Nicklas, 2003).

The percent distribution of the adolescent boys and girls according to the frequency of consumption of milk and milk products is presented in Table 9

Table 9: Percent distribution of the adolescent boys and girls according to the frequency of consumption of milk and milk products

S.No	Food Items	Frequency	Boys		Girls	
			Private (n=125)	Government (n=125)	Private (n=125)	Government (n=125)
1	Milk – Plain or Flavored	Never/Rarely	16	15.2	1.6	27.2
		Monthly once	1.6	4.8	1.6	9.6
		Once in 15 days	2.4	0	0	6.4
		Once a Week	7.2	17.6	11.2	5.6
		Daily	72.8	62.4	79.2	51.2
2	Curd	Never/Rarely	25.6	24.8	8	20
		Monthly once	4	6.4	4	9.6
		Once in 15 days	8.8	1.6	2.4	15.2
		Once a Week	32.8	37.6	44	25.6
		Daily	28.8	29.6	41.6	29.6
3.	Paneer	Never/Rarely	54.4	56.2	59.2	77.6
		Monthly once	11.2	9.1	8	1.6
		Once in 15 days	9.6	8.3	27.2	10.4
		Once a Week	18.4	11.6	5.6	10.4
		Daily	6.4	14.8	0	0
4.	Cheese	Never/Rarely	48.8	48.8	59.2	62.4
		Monthly once	14.4	4.8	20.8	9.6
		Once in 15 days	7.2	14.4	11.2	8.8
		Once a Week	22.4	28	8	16.8
		Daily	7.2	4	0.8	2.4
5.	Khoa	Never/Rarely	62.4	44	67.2	36
		Monthly once	10.4	12.8	19.2	20.8
		Once in 15 days	14.4	9.6	8.8	23.2
		Once a Week	8	29.6	0	20
		Daily	4.8	4	4.8	0
6.	Ice Cream	Never/Rarely	12	10.4	0	6.4
		Monthly once	20	24	74.4	32
		Once in 15 days	19.2	21.6	7.2	23.2
		Once a Week	28	31.2	17.6	38.4
		Daily	20.8	12.8	0.8	0

The impact of a nutrition education program on the sub sample

A nutrition education program was formulated and conducted for the sub sample of 50 adolescents to create awareness on the importance of calcium consumption. The effectiveness of the program was assessed using pretest and post test checklist consisting of 20 questions on knowledge and awareness. There was a significant difference in the knowledge level of the adolescents before and after the nutrition education program which is evident from the scores presented in Figure 1. The difference was significant at 1% level. The effect of the nutrition education program was evident in both those who were consuming adequate calcium in their diet as well as in those consuming inadequate levels of calcium, as assessed by dietary recall data. This indicates that the program had a positive impact on the knowledge of these adolescents.

Nutrition interventions, especially those that are behaviourally based, have been effective in producing dietary behaviour change among adolescents (Feskanich et al 2004).

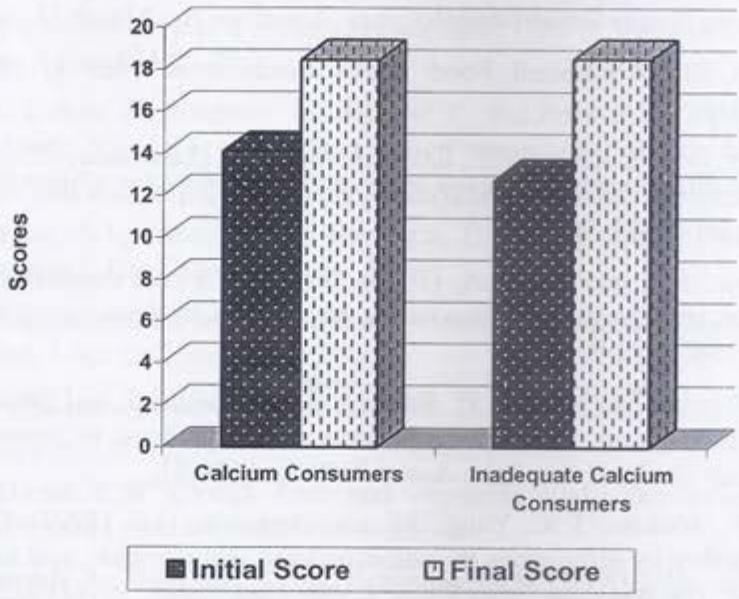

Figure 1: Mean value of pre and post test scores

SUMMARY AND CONCLUSION

The prevalence of inappropriate food consumption patterns and food choices among adolescence paves the way for faulty dietary habits to emerge. The study shows that majority of adolescent boys and girls were non-vegetarian. Skipping breakfast is more common among girls and hence they are less likely to meet their adequate requirement for calcium and other nutrients. Irrespective of gender and type of institution majority of adolescent boys and girls consume lunch packed from home and had dinner along with a family. Calcium supplement usage was more predominantly seen among girls rather than boys. Frequency of food intake data revealed poor intakes of calcium rich sources in the diets of adolescents.. There was a significant difference in the knowledge level of the adolescents before and after the nutrition education programme. Thus the present study reveals the need to plan nutrition education programme for the adolescents

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IRON NUTRITURE OF INDIAN CHILDREN RESIDING IN AN URBAN SLUM WITH REFERENCE TO DIETARY IRON INTAKES

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The objective of the study was to analyze the food intake pattern of children residing in an urban slum in relation to their iron intakes and nutritional status. A total number of 360 children between 4-14 years were selected from a slum area of Mysore city. Data regarding the food intake and iron adequacy, somatic status and iron nutriture was collected through standard techniques. Results revealed that the incidence of underweight was higher in older children. Mild stunting and wasting was seen in majority of children from all age groups. The diets were deficient in protective foods like green leafy vegetables, milk and milk products and pulses. The intake of other vegetables and cereals was nearer to recommendations. The prevalence of anemia was very high with 93% of children showing some degree of anemia. 21% suffered from mild degree of iron deficiency anemia, whereas 6% had severe degree of anemia. Most of the dietary iron was derived from cereals (29-38%) and vegetables (35-43%) and a negligible amount was from animal foods. The percent adequacy of dietary iron intake was significantly associated with age of children.

KEY WORDS: Underweight, stunting, wasting, iron deficiency anemia, food frequency.

Iron the trace element required for controlling a wide range of functions in the human body is required in milligram quantities per day. Deficiency of the micronutrient results in anemia, which is prevalent all over the world and to a large extent in developing countries. It is a global nutritional problem with about 40% of the world's population being anemic (Murray and Lopez, 1996). The prevalence is extraordinarily high among all age groups and especially in developing countries with figures being four times that of developed countries. Current estimates of anemia for developing countries are for pregnant women 56%, for school children 53%, for preschool children 42% and for men 33%. Asia has the highest rates of anemia in the world. In India, the prevalence of anemia is 50% in women and 74% in small children and between 67-77% among 5-14 year olds in low socio-economic groups of both urban and rural households (Verma et al., 1998). The high prevalence rate of 19-88% of anemia even among the children of urban high socio-economic groups reported recently has been quite surprising (Srihari et al., 2007).

The consequences of iron deficiency anemia are manifold, and much of it is reversible, with better access to and absorption of iron. Evidences suggest that iron deficiency anemia affects the metabolic processes, reduces physical and developmental activity, impairs immune system leading to ill health among preschoolers, and scholastic performance in addition to other impairments in school children. In infancy and childhood, iron deficiency results in impaired motor development and coordination, impaired language development and scholastic achievement, psychological and behavioural effects and decreased physical activity. In adults

there is fatigue, decreased physical work efficiency and earning capacity. In pregnant women, there is increased maternal and fetal morbidity and mortality (Ramakrishnan, 2001).

The major cause of iron deficiency is low intake of dietary iron and extreme poor bioavailability due to presence of many inhibitors in habitual dietaries of some countries, India being one among them. The situation is also compounded due to excessive worm infestation due to unhygienic surroundings. Despite implementation of large-scale nutritional intervention/prophylaxis programs iron deficiency anaemia still continues to be a public health problem in most of the developing countries (Allen and Sabel, 2001).

In children apart from the immediate adverse effects of iron deficiency,the losses could extend into adulthood affecting the productivity adversely in terms of skilled or unskilled labour. The loss due to cognitive deficits can be huge and difficult to assess. It could be substantial for the future knowledge based societies. The iron intakes are especially low in children from lower socioeconomic group due to limited food choices, quantitative inadequacy of foods and poor care. Though the prevalence trends are changing and it is being explored that anemia occurs in all age groups, preschoolers are the most researched group and also their health and nutritional status has gained priority at national level. School age children, especially those of slum dwellers are neglected in this regard. In India approximately 19% (190 million) of the growing population comprises of school age children of whom 30% are from urban areas, a significant number of these reside in slum areas. The objective of this study was to analyse the nutritional status of children belonging to an urban slum with reference to iron and to determine their dietary intakes.

METHODOLOGY

An urban slum by name, Ghousianagar, from the city of Mysore with predominantly Muslim population was selected as the study area. A sample of 360 children between the age of 4-14 years attending the school and preschool (Anganwadi center) located in the slum were enrolled for the study.

Nutritional status of children

Children were assessed for age, weight, height and haemoglobin levels. Exact age was computed by referring the date of birth records maintained in the school and preschool. For the purpose of computation, children born before 15th day of the month were considered for the previous month whereas those born after the 15th day of the month were considered for the next month. Weights of the children were recorded using an electronic balance (Essae Digi Scale, Model DI -20, No. P2 000039667/2), to the nearest of 0.1 kg by standard techniques. Heights of all the children were recorded with the aid of a non-stretchable fiberglass tape to the nearest of 1.0 mm on enrollment. The weight and height data of children was analyzed using various indices to determine the extent of underweight, stunting and wasting (Rao and Vijayaraghavan, 1996). For hemoglobin estimation, blood samples of a sub-group of children were collected by finger prick method on a filter paper. Hemoglobin content was analyzed by Cyanmethemoglobin method (Demayer, 1989). Based on the hemoglobin values the children were classified into different grades of anemia as per WHO standards (WHO/UNICEF/UNU, 2001).

Diet survey

The dietary intake of children was determined using food frequency and 24 hour recall method. Information on the frequency of consumption of all foods of all groups was elicited by interviewing the mothers of the children using an open-ended questionnaire. The data was collected for frequency of consumption for a month and converted to average daily consumption by computing the overall intake in a month. It was expressed as average daily intake of foods by percent of families. Mothers of the children were also interviewed to get information on the foods, beverages and snacks consumed by the children in the preceding 24 hours. These were recorded using a set of cups (75-250ml), ladles and tumblers that were standardized in the laboratory for the commonly consumed recipes of that area. The diet survey data was collected on two consecutive days in the middle of the week and averaged to obtain information on regular diet pattern of the selected subjects.

The foods consumed were converted into raw foodstuffs using the values standardized in the laboratory. The contribution of different foods to intake of iron was computed using food composition tables (Gopalan et al., 1996). The percent adequacy of iron was calculated by comparing the nutrient intake of children with the Recommended Dietary Allowances (RDA) for Indians in relation to their age (ICMR, 1990).

The data was analyzed statistically using statistical packages SPSS version 10.0 and MINITAB. Probability level was fixed to $P \leq 0.05$ for all analysis. The level of significance indicated for the data is as follows – ns: not significant, *:$P \leq 0.05$, and ***:$P \leq 0.001$.

RESULTS AND DISCUSSION

Nutritional status of children and prevalence of anemia

The nutritional status of children with respect to weight and height is presented in Table 1.

Table 1: Nutritional status of children - Agewise distribution (in percent)

Indicator	Total No.	Normal	Mild	Moderate	Severe
Underweight					
4-6	72	8.3	23.6	55.6	12.5
7-9	186	8.1	46.2	40.9	4.8
10-11	77	6.5	38.9	48.1	6.5
13-14	25	8.0	4.0	52.0	36.0
Total	360	7.7	37.2	46.1	9.0
X^2= 43.747***					
Stunting					
4-6	72	54.2	38.9	5.5	1.4
7-9	186	41.4	36.0	21.5	1.1
10-11	77	41.6	35.1	22.0	1.3
13-14	25	36.0	48.0	16.0	-
Total	360	43.6	37.2	18.1	1.1
X^2 = 12.017ns					
Wasting					
4-6	72	54.2	38.9	5.5	1.4
7-9	186	42.5	32.8	23.6	1.1
10-11	77	41.6	36.3	20.8	1.3
13-14	25	36.0	48.0	16.0	-
Total	360	44.2	35.8	18.9	1.1
X^2 = 13.577ns					

[***:$P \leq 0.001$., ns: not significant]

When weight for age of the children was taken into as the criteria, only a small proportion of children (7.7%) were found to be normal. Mildly underweight children were more in 7-11 year group but moderate malnutrition increased in children between 4-6 years and 13-14 years of age indicating the vulnerability of subjects during preschool years and during secondary growth spurt. Many of the older children were severely underweight. The difference between the nutritional status of children between different age group was statistically significant. When the nutritional status was analysed keeping the criteria of height for age, which denotes stunting, the percentage of children falling into normal grade was higher in younger age groups and decreased with increasing age indicating deterioration in attaining height with increasing age. Mild stunting was more in all age groups than moderate stunting. However, severe stunting was very low. The differences between different groups were statistically non- significant. The incidence of mild stunting was higher in all age groups, though 36.0-54.2% of children also were found to have normal height for weight ratio. A considerable number were also found to have moderate wasting between 7-11 years of age. On the whole it can be said that children were found to be suffering with different degrees of undernutrition in all age groups as judged by their weight and height.

The prevalence of anemia in relation to age of children is presented in Table 2.

Table 2: Prevalence of anemia in children in relation to age

Age group (years)	No.	Normal		Mild		Moderate		Severe	
		No.	%	No.	%	No.	%	No.	%
4-6	72	7	9	9	12	47	66	9	13
7-9	186	9	5	34	18	134	72	9	5
10-11	77	7	10	24	30	46	60	-	-
13-14	25	4	16	8	32	10	40	3	12
Total	360	27	7	75	21	237	66	21	6
$X^2 = 29.309^{***}$									

[***:P ≤ 0.001]

Haemoglobin levels revealed that 93% of the selected children were subjected to various degrees of anemia, of whom 66% were in moderate and 6% in severe degrees. However, the pattern varied by the age of the children with the differences being significant. The proportion of children with normal haemoglobin level was comparable in younger and older groups but it was around 5% in the 7-9 year group. Mild form of anemia increased with age, it increased by 0.5 and 2.5 times in the 7-9 and 10-11 year groups (school age) compared to 4-6 year preschool children. Moderate form of anemia was highest in the 7-9 and lowest in the 10-11 year groups. Severe form of anemia showed a reducing trend with increasing age and became nil in the 10-11 year group. However, it was higher again during 13-14 year age groups showing increasing requirements during growing period.

The prevalence of anemia among the 4-6 year group is similar to that reported by various investigators in the low socio-economic groups of rural areas ranging from 48-95% placing all states of India under the high magnitude category (NFHS, 2007; Seshadri, 1997; Lakshmi et al., 2001), prevalence of moderate and severe degrees of anemia among 7-11 year group of the present study is comparable to that reported from urban slums of Meerut (Jain et al., 2000). But the reports of Gur et al (2005) and Gomber et al (2003) have shown a prevalence of 28 and 40% respectively among the school children residing in slum areas. These discrepancies in prevalence

rates among slums could be due to differences in age groups included, sample size, slum setting, availability and consumption of various diets etc.

Evidences suggest that dietary inadequacy, parasitic infestations, family size and nutritional status are the factors known to influence iron deficiency anemia among school children (Gur et al., 2005; Gomber et al., 2003; Kapoor et al., 2002; Lakshmi et al., 2001). The present study results are in agreement with the other reports showing a low intake of iron. The bioavailability of dietary iron is further influenced by its chemical form, proportion of inhibiting and promoting constituents along with iron nutritional status of the individual. The selected subjects being non-vegetarians, their diets contained sufficient amount of heme iron but the frequency of consumption of meat products is less and this fact narrows down the beneficial effect. Their fruit consumption is negligible and very rare, the quantity of the absorption promotive organic acids are less and hence iron from their diets are poorly bioavailable.

Food frequency in relation to iron intake

Diet is one of the prime determinants of health and nutritional status. Dietary surveys therefore are one of the essential components of nutritional assessment. Assessing dietary adequacy in terms of quality and quantity are equally important. The food frequency pattern of selected families and iron contents of foods is presented in Table 3. This data gives an idea about the frequency of consumption of foods in relation to their iron content, which varies considerably for different foods.

Among cereals, rice, wheat and ragi were frequently consumed. Rice was the staple cereal of all families, while wheat and ragi were consumed at a lesser frequency (49.1 and 35.9% respectively). However, it may be noted that iron content of rice is comparatively much lower than wheat and ragi, hence though the diets may be cereal based, the comparative contribution of iron becomes lesser from cereal group. Similarly among legumes and pulses, red gram dhal has lowest contents of iron but the intake is on daily basis by all families. Other dhals and legumes with a higher iron contents were used less frequently. Among vegetables different varieties were consumed. The usage level was dependent on the price and seasonal availability. Tomatoes and onions were items used daily. Other vegetables commonly used were beans, radish, cucumber, drumsticks and ladies finger. Among green leafy vegetables, coriander and curry leaves are used everyday, since these are used for garnishing and flavouring. In other greens, spinach, amaranth, shepu and fenugreek were commonly consumed. The consumption of fruits was less frequent with only banana being most commonly used. This can be attributed to high cost of fruits. Fruits and vegetables in general were fair sources of iron.

Milk and milk products, though poor source of iron were used at different frequencies, Milk was used regularly by all the families but mainly in the form of coffee or tea. Curds and buttermilk formed the daily menu component only in 25-35% of the families while more than 50% of them used it rarely as they could not accommodate it in their budget. Their use is beneficial since they are highly nutritious and are classed as protective foods. Since the study subjects were from Muslim community, all of them were non-vegetarians, however, the frequency of consumption of flesh foods was less due to economic constraints. Among flesh foods, beef meat was consumed more than other foods. Around 35% of the families were consuming lamb meat 1-2 times a week

while 40% were using it on a fortnightly or monthly basis. Beef meat was used by 75% of families on weekly and 11% on monthly basis. Fish and chicken were less frequently used due to cost reasons. Eggs were consumed more commonly (by 33.8% of families on daily basis.)

Table 3: Frequency of consumption of food stuffs by families and their iron contents (expressed as average daily use by % of families)

Foods	Iron content (mg/100g)*	Frequency of use	Foods	Iron content (mg/100g)*	Frequency of use
Cereals			**Roots and tubers**		
Rice	0.7	100	Potatoes	0.48	18.3
Wheat	4.9	49.1	Carrot	1.03	7.5
Ragi	3.9	35.9	Radish	0.40	17.7
Legumes			Onion	0.60	100
Red gram dhal	2.7	100	Beetroot	1.19	5.5
Bengal gram dhal	5.3	10.4	**Fruits**		
Green gram dhal	3.9	15.2	Apple	0.66	1.5
Black gram dhal	3.8	8.2	Banana	0.36	14.8
Green gram	4.4	7.7	Orange	0.32	1.2
Bengal gram	4.6	8.6	Papaya	0.50	3.8
Horse gram	6.8	8.2	Guava	0.27	0.5
Vegetables			Jack fruit	0.56	0.5
Bitter gourd	0.61	4.4	**Green leafy vegetables**		
Bottle gourd	0.46	11.2	Spinach	1.14	14.2
Brinjal	0.38	9.3	Amaranth	3.49	12.9
Beans	0.61	31.1	Shepu	17.4	11.0
Cauliflower	1.23	2.6	Fenugreek	1.93	11.2
Cluster beans	1.08	1.4	Coriander	1.42	100
Cucumber	0.60	12.6	Curry leaves	0.93	100
Drumsticks	0.18	12.4	Cabbage	0.80	4.4
Capsicum	0.57	2.2	**Milk and milk products**		
Knol-khol	1.54	2.5	Milk	0.2	100
Ladies finger	0.35	12.6	Curds	0.2	36.3
Pumpkin	0.44	3.0	Butter milk	0.1	28.1
Ridge gourd	0.39	7.2	**Flesh foods**		
Tomatoes	0.64	100	Meat (lamb)	2.5	9.7
Tender peas	1.5	1.2	Meat (beef)	0.8	17.6
Sugar	-	100	Chicken	2.52	5.5
Coconut	1.7	100	Fish	2.0	7.3
Fats & oils	-	100	**Egg**	2.1	33.8

* Nutritive value of Indian Foods (1996)

On the whole, it can be said that their diets were cereal based. Consumption of milk and milk products, fruits and vegetables were far from satisfactory. Their economic position had limited the usage of the micronutrient rich sources. However, the frequency of consumption of meat and meat products was found to be better than those reported for low socio-economic groups of rural areas of our country (Lakshmi et al., 2003, 2005).

Iron intake and adequacy

Adequacy of a nutrient is generally assessed on the quantity of intake in relation to RDA. However in case of iron adequacy, bioavailability of the mineral needs to be considered in addition to quantity. Bioavailability of dietary iron is the proportion of iron i.e. actually available for absorption and utilization by the body. Bioavailability of dietary iron depends on several factors such as physico-chemical form, iron nutriture and meal composition etc. In meat products iron is present in 'heme' and in plant foods as 'non-heme' form. Heme iron is well absorbed as its absorption is unaffected by meal components, it ranges from 15-35% depending on the iron status of the individual. Absorption of non-heme iron is greatly influenced by the proportion of absorption enhancers and inhibitors present in the meals, it ranges from 2-20% in Indian diets (Monsen, 1988; Miller et al., 1981).

The iron content of the diets of the children and the proportion of iron derived from different food groups were calculated. As evident from Table 4, 28-38% of iron was derived from cereals in the diets of the children of 4-14 year group.

Table 4: Percentage of iron derived from different food groups

[*:P ≤ 0.05, ***:P ≤ 0.001, ns: not significant]

Age group (in years)	Iron intake (mg)	Percent Adequacy	Percent iron from			
			Cereals	Pulses	Flesh foods	Vegetables
4-6						
Mean ± SD	6.51 ± 2.02	37.5	28.62 ± 11.53	17.48 ± 14.77	9.59 ± 14.56	42.92 ± 23.83
Median	5.77	-	26.76	18.72	6.23	40.82
7-9						
Mean ± SD	7.74 ± 3.91	32.2	30.88 ± 16.29	17.93 ± 16.81	9.98 ± 15.88	40.97 ± 20.93
Median	6.88	-	26.16	14.59	6.46	37.91
10 -12						
Mean ± SD	9.16 ± 3.52	44.0	36.29 ± 16.97	18.04 ± 15.26	8.30 ± 11.29	37.18 ± 19.66
Median	8.72	-	32.17	15.80	5.23	37.22
13-14						
Mean ± SD	9.79 ± 3.76	33.4	38.21 ± 17.58	18.71 ± 16.59	7.29± 9.51	34.94 ± 23.36
Median	9.03	-	40.30	18.49	2.62	28.77
F Ratio	12.3297*	-	6.59 ***	0.0488 ns	0.9250 ns	2.3745 ns

A gradual increase in the percentage of iron derived from cereals was observed with increasing age and the extent of increase was found to be extremely significant ($P \leq 0.01$). An age associated increase in the quantity of cereal intake would correspondingly increase the quantity of iron from the cereal group.

The quantity of iron derived from the 'pulse' group ranged from 17.5 to 18.7%. Increase in quantity of pulse intake with age was found to be non-significant as per ANOVA. Meat and meat products provided around 7.3-9.9% of the total iron in the diets of children of different age groups. Though the quantity derived from meat products is comparatively less, it is present in the heme form, which is better absorbed than that derived from other sources.

The efficiency of absorption of the iron derived from plant foods is reported to be several times lower than heme iron. No sex differences existed in the proportion of iron derived from different food groups. Though the vegetable consumption was found to be lower than the desirable level, their contribution for the dietary iron was notable. It ranged from 34-42%. The proportion contributed reduced with increasing age but the extent of decrease was non-significant. Generally it is said that most of the micronutrients are derived from cereals in the dietaries of low socio-economic groups but it was surprising to see that both cereals and vegetables contribute an equal proportion of iron.

Dietary Iron intake and severity of anemia

A large proportion of children in the study suffered from moderate grades of anemia, and the number of children without anemia or with severe grades of anemia were very small. Hence, significant differences were not seen when the iron adequacy of the diet was examined in relation to severity of anemia. The diet structures and iron intake were more or less similar in children with different grades of anemia. As stated earlier, apart from diet there could have been other issues affecting the incidence and extent of anemia such as worm infestation, which were not examined.

CONCLUSION

The conclusions drawn from the results of the present study are as follows – An analysis of nutritional status of children showed that most of the children were malnourished. The incidence of underweight was much higher in children than stunting or wasting. The severity of undernutrition increased with increasing age. 66% of children were suffering with moderate degrees of iron deficiency anemia. The diets showed lack of protective foods and a lesser intake of iron rich foods. The percent adequacy of diets ranged from 32-44 and most of the iron in the diets was contributed from cereals and vegetables. It is recommended that intake of iron rich foods and promoters of iron absorption need to be encouraged in diets of children to combat iron deficiency anemia in this population.

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A SURVEY ON THE PURCHASE, STORAGE AND CONSUMPTION OF SELECTED SPICES AND SPICE MIXES IN MUMBAI.

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A rapid assessment survey of 180 women belonging to low, middle and high income groups from North, Central and South Mumbai was conducted to collect information on the preference, purchase, consumption and storage patterns of spices and spice mixes and their general awareness about spices. Across all the income groups, majority of the participants procured spices and spice mixes from the local grocery shop or street vendor (93.3% in the low, 96.7% in the middle and 78.3% in the high income group) and preferred to store the procure under ambient conditions rather than refrigeration. It was evident from the survey that despite the advances in spice processing and their availability in the market, participants preferred home made spices. Nearly 55% of the participants preferred buying unbranded spices and spice mixes. Among the consumers of branded products, majority of the consumers favored the brand Everest. Interesting information on the therapeutic benefits of spices was also reported by the participants.

The term spice is derived from the Latin word "*species*" meaning fruits of the earth (Balakrishnan 1991). From ancient times India has been the world's producer and exporter of spices (Nath 1974). There are about 70 different spices growing world wide and India produces most of these (Pruthi 1987). With the changing cooking trends and increased emphasis on convenience, most spices are marketed nowadays in the ground form. Most of the researches on ground spices include shelf life studies of irradiated spices packaged in varying packaging materials carried out in the laboratory conditions (Subbulakshmi, G., Udipi, S. and Raheja, R. 1991 and Munasiri, M.A., et al 1987). Despite the fact that ground spices and spice mixes assume a pivotal role in Indian cookery on a daily basis, there is limited data that takes into account its practical use at the household level. There is very little published information on the practices related to their purchase and storage. Although the spice industry acts as a significant contributor to the nations' economy (V.B. Singh and K Singh 1996); there is a need for understanding the factors that influence a consumer's choice, buying configuration, use and storage of spices and their products. Therefore the present study aimed at collecting information on the purchase, consumption and storage patterns of spices and spice mixes from various income groups in Mumbai and also at assessing the awareness of the consumers regarding the optimum processing techniques and therapeutic benefits of spices.

MATERIALS AND METHODS

Rapid Assessment (RAP) is a holistic methodology designed to organize macro and micro level data into one. This involves synthesizing data on health structures, health beliefs and perceptions for the explanation of health-seeking behaviour. Qualitative data on individual perceptions, beliefs, values and definitions of the situation are central to RAP. All the United Nations agencies involved in health development, and donor agencies such as the Ford Foundation and the International Development Research Council (IDRC) are committed to participatory and action-

oriented strategies for development. RAP is applied by these agencies for programme development, collection of baseline data, and development of instruments for larger monitoring or evaluation studies. The qualitative methodologies adopted by each agency are usually designed to suit its program priorities. However, it is apparent from the papers reviewed that RAP is also used for collection of baseline data besides being used for the programme development, monitoring and evaluation , and Information, education and communication (IEC). When RAP is used for programme development it is described as a formative research tool and is used for collecting information for developing a programme or product for the end users. Since the present study aimed at collection of baseline information on the consumer behavior related to spices and spice mixes, the use of RAP for the same is justified.

A rapid assessment survey of 180 women belonging to the North (Goregaon, Kandivali, Borivali, Mulund), Central (Mahim, Bandra, Khar, Santacruz, Andheri, Sakinaka, Vikhroli, Kanjurmarg, Sion, Chunabhatti, Deonar,) and South (Dadar, Wadala, Parel, Girgaon, Gamdevi, Charni Road, Kalbadevi, Byculla, Worli, Marine Lines, Tardeo, Fort) Mumbai areas was conducted by administering a questionnaire cum interview method. Participants represented (90 from each group) 3 different family income groups i.e. the low income (earning </=Rs.5000 / per month), middle income (earning Rs.5000 - 12500/ per month) and upper income (earning Rs.12500-70000/ per month) groups as per the classification provided by the Rationing Office, Bandra, Mumbai. The survey was used to elicit information from the participants on the preference, purchase, preparation, consumption, storage practices, potential health benefits of spices and spice mixes. Analysis of the data was done using the Statistical Package for Social Sciences (SPSS) version 10.0.

RESULTS AND DISCUSSION

From the results of the survey it was understood that considerable amount of the monthly income was spent on food by the low and middle, not by the high-income group families i.e. 89.6%, 78.27% and 20.95% of the monthly income was spent on food alone respectively. It was also observed that the food expenditure per head was Rs. 769.96/- in the low, Rs. 1339.67/- in the middle and Rs 1738.33/- in the high-income groups. The average number of family members was 3 in the lower and 4 both in the upper and middle income groups. 90% of the participants from the low-income group spent around Rs.2000/-per month on food. However the amount for the same varied from Rs. 4000-6000/- and Rs.5000–10000/- per month for most of the participants in the middle (81.6%) and high (76.7%) income groups respectively.

Reasons for spice consumption as stated by the consumers:

Spices play a central role in Indian cuisine (Patankar and Bharati 2001). They add flavor and color to bland meals and also act as preservatives in foods like sausages, pickles, sauces and chutneys (Pruthi 1987). This fact was further evidenced in the survey as 98.3% of the participants stated that spices and spice mixes were important in cookery. When the participants were asked the reasons for their responses, 74.4% participants said that they added spices for enhancing taste, 56.7% participants added for flavor where as 37.8% participants did so to enhance color. Some participants thought that spices could help to increase palatability, aroma, vitamin intake, heat characteristics, pungency, spiciness or antioxidant content. Spices and herbs are commonly used in the indigenous Ayurveda medicinal system in India (Rani 1992). Some spices demonstrate

therapeutic properties like anti-inflammatory, antibacterial and anti oxidant activity (Srilakshmi 2001). The same was reflected in the survey as 11.11% participants valued spices for their potential health benefits or medicinal use. Some of the health benefits as reported by the participant have been tabulated below (Refer Table 1).

Table 1: Therapeutic Benefits of Spices as reported by the Participants

THERAPEUTIC BENEFITS	SPICE
Useful in Gastrointestinal disorders like acidity, vomiting, nausea, hiccups, bad breath, ulcers, stomach problems or aches, pith, digestion, gas trouble, diarrhea, constipation, gastritis, jaundice, colic pain or piles	Asafoetida (73.3%), Omum (55%), Cardamom (4.4%), Cumin (25%), Coriander (15.6%), Garlic (11.1%), Ginger (32.2%)
Relieve problems (diseases or infections) associated with the respiratory tract like chest congestion, coughs, sore throat and colds	Cardamom (4.4%), Pepper (14.4%), Ginger (22.8%), Turmeric (16.1%), Cinnamon (21.7%)
Anti infective / antibiotic, prevents food poisoning, useful for blood purification, useful for wound healing, antiseptic, abate worms or antibacterial	Turmeric (43.9%)
Useful in metabolic disorders like heart problems, chest pain, hypertension, hypercholesterolemia, diabetes or increases the blood circulation	Fenugreek (15.6%) Garlic (25%)
Helps in maintaining the temperature balance as in fevers or used as a coolant or for heat providing effect	Coriander (29.4%) Cumin (27.8%)
Alleviates aches and pains like tooth aches, ear aches, back aches, joint aches, headaches or arthritis	Cloves (55%)

Besides these, some other health benefits of spices as appetizers, diuretics, blood clotting facilitators, brain cell activators, promoters of hair growth, removal of body odor & motion sickness, sleep inducers, alleviators of burn scars and giddiness, sore eyes relievers, fat burners, useful in skin disorders and reproductive health such as in suppressing menstrual cramps or as galactogogues post delivery were also reported. However spices like chilli, fennel, saffron and mustard were not reported to have any considerable therapeutic benefits. Graig (1999) reported that a variety of phytochemicals like flavonoids, terpinoids, lignins, polyphenolics, carotenoids, coumarins, sterols were present in different herbs and spices. It is due to the presence of such active components that spices have found their role in a wide spectrum of health and disease ranging from antimicrobials to antimutagenic components. (Subbulakshmi G. and Naik M.2002) Although the Ayurvedic texts document several health benefits of Indian spices and herbs, data presented above are based on participant beliefs alone.

Spice purchase practices of the consumers

The assessment of the buying behavior of the participants showed that in actual practice most (n=161) of the participants procured spices and spice mixes from the local grocery shop or street vendor and this consumer behavior was reflected across all the income groups (93.3% in the low, 96.7% in the middle and 78.3% in the high income group). It was interesting to note that despite the advent of supermarkets and an increase in the purchasing power among the high-income group, the participants still preferred to buy spices and spice mixes from the local grocery shops

or street vendors. This could be due to several reasons i.e. the trust of the consumers on the local vendors, convenience (availability at the doorstep or closeby location and in bulk packaging compared to the small packs available in the supermarkets) and lower cost of the spices sold by local vendors as compared to the prices at which these are offered in the supermarkets

The information elicited on the preference patterns for spices and spice mixes across the population, exhibited that nearly half (53.3%) of the participants preferred making spice powders and spice mixes at home where as the other half (44.4%) preferred buying ready made spice powders and spice mixes and this behavior was common to both the middle and high income groups. However in the low income group most of the participants (71.7%) preferred to make spice powders and spice mixes at home due to monetary constraints.

Difference in the preference for branded and unbranded spices was noticed among the participants. It was observed that across all the participants, nearly 55% of them preferred buying unbranded spices and spice mixes, while 22 and 23% of the participants preferred branded and both (branded as well as unbranded) spices and spice mixes. However in the middle and high income groups nearly 55 and 51.7% of the participants stated a preference for branded spices and spice mixes. In the low-income group the main reason for the purchase of unbranded spices and spice mixes (66.7%) was their low cost while some (11.7%) still preferred home made spice products. In the middle-income group also, cost (35%) was the determining factor for deciding on the purchase of branded or unbranded spices and spice mixes where as the preference for home made spice products (13.3%) and assured quality (11.7%) were also some of the commonly stated reasons. It was interesting to observe that due to the affordability, low cost (1.7%) was not the contributing factor for the purchase of spices and spice mixes in the higher income group. Among these participants, the assurance of quality (33.3%) was the major decisive factor for their purchase and a preference for homemade spice products (16.7%) was also reported.

This striking consumer preference for unbranded spices and spice mixes seen in a substantial number of participants from middle and high-income groups, despite their affordability could possibly be due to the limited availability of branded whole spices as only few in-house brands of supermarkets e.g. Big Bazaar, Dmart, etc or lesser known brands like Shree products offer the same or due to the trust on the supplier or convenience as mentioned earlier. It is worthy to note that more than half of the participants in the high income and middle income groups preferred to buy ready to use spices and spice mixes for the sake of convenience but they still prefer the homemade products for the commercial ones because homemade products were considered of good overall quality and traditional. While convenience is one of the most marketed and overrated characteristics for the purchase of any processed food product, the survey revealed that Indian consumers still prioritized tradition over convenient technology, at least as far as purchase of spices was concerned.

While studying the brand preference, it was observed that among the consumers who purchased branded spice powders Everest was the most preferred brand. This was true even for the spice mixes, where majority of the consumers favored the brand Everest (n=83), followed by Badshah (n=32), MDH (n=8), Bedekar and MTR (n=5 for both). The least preferred brands were Sanjeev

Kapoor, Mother's Recipe, Parampara and Melam Amrut, Atash, Rainbow, Eastern Curry Masala and Khamkar.

Spice purchase and consumption patterns:

Table 2 presents the average spice consumption by the participants

Table 2: Average Consumption of Spices by the Participants.

Spices	Average Intake (g/yr)	Spices	Average Intake (g/yr)
Cloves Pd	12.17	Garlic Ps	351.78
Cinnamon Pd	13.5	Ginger Ps	378.95
Small Cardamom Pd	14.11	Fenugreek Wh	398.46
Fenugreek Pd	16.67	Chilli Wh	499.28
Big Cardamom Wh	19.83	Asafoetida Pd	571.89
Cumin Pd	109.56	Mustard Wh	1165.99
Pepper Pd	121.88	Cumin Wh	1262.81
Omum Wh	164.61	Coriander Wh	1290.23
Small Cardamom Wh	171.96	Turmeric Pd	1558.86
Cloves Wh	177.24	Ginger Wh	2185.57
Cinnamon Wh	178.08	Chilli Pd	2239.26
Coriander Pd	283.49	Garlic Wh	4501.26
Pepper Wh	313.3		

Wh ~ Whole, Pd ~ Powder, Ps ~ Paste

The survey demonstrated that the participants used all unbranded individual spices except for asafetida (brand Vandevi was used). It was also seen that most of the above mentioned spices were used daily, except for whole fenugreek (2/wk), whole and ground cloves, cinnamon and powdered small cardamom (1/wk) and big and small whole cardamom (1/fortnight).

In the low-income group, most participants preferred the Mix masala and Garam masala, which are multipurpose spice mix powders that have been conventionally used in most of the Indian preparations. The most commonly used spice mixes in the middle income group were coriander-cumin powder, followed by Mix masala and Garam masala where as in the high income group garam masala was most frequently consumed. Quite predictably use of the more exclusive spice mixes like meat, chaat, chole, pav bhaji, sambar, rasam, fish masalas and ginger garlic paste were not seen among the low income groups as the probability of such food preparations in these households would be bleak. On the other hand the consumption of ghati, bottle, malwani and goda masala which are culture specific, regional spice mixes were not very frequently used depicting a changing trend in the eating patterns of today's modern families. The average per capita consumption of spices in south India was reported as 9.54g by Uma Pradeep, K., Geervani, p. and Eggum, B.O.(1993). However a slightly lower intake was recorded by Potty, (2002) who stated that the annual per capita consumption of spices in India was 3140g.

Table 3 presents the pattern of purchase and consumption of spice mixes by the participants.

Table 3: The Purchase and Consumption of Spice Mixes Consumed by the Participants.

Spice mix	Average Intake (g/yr)	Frequency	Branded/ Unbranded
Jaiphal Cardamom Mix	0.67	1/15 days	Unbranded
Tava M	1.67	1/15 days	MDH
Rajmah M	1.67	1/15 days	MDH
Amti M	1.85	2/wk	Homemade
Tandoor M	2.36	1/wk	Everest / Homemade
Usal M	3.33	1/wk	Homemade
Kada M	4.44	1/wk	Unbranded
Chicken M	6.67	1/wk	Everest
Kitchen King M	7.33	2/wk or1/15 days	Unbranded/ Everest
Jaljira M	15.33	1/15 days	Jalani
Vegetable M	16.67	2/wk	Everest
Meat M	17.78	Alternately or 1/wk	Homemade/ Everest/ Badshah
Biryani M	18	1/15 days	Everest
Pulav Mix	21.94	1/15 days	Everest
Green M	22.22	Daily or1/wk	Homemade
Rasam M	23.56	1/15 days	MTR / Badshah / Bedekar / Everest / Homemade
Fish M	38.89	Alternately	Homemade
Ghati M	38.89	Daily	Unbranded
Mutton M	53.52	1/wk	Everest
Pani puri M	54	1/15 days	Everest
Chaat M	100.42	2/wk	Everest
Goda M	125.42	2/wk	Unbranded
Chole M	126.3	1/15 days	Everest
Sambar M	183.38	1/15 days	Everest
Bottle M	214.07	Daily	Homemade
Pav Bhaji M	232.21	1/15 days	Everest
Ginger + Garlic Ps	364.23	Daily	Unbranded
Coriander-Cumin Pd	426.39	Daily	Unbranded
Garam M	618.14	Daily	Everest
Mix M	1243.8	Daily	Unbranded

M~ Masala , Pd ~ Powder, Ps ~ Paste

Spice preservation/storage practices

The assessment of the storage patterns of the participants revealed that majority (n=122) of the participants (66.7 % low, 73.3% middle, 63.3% high income groups) reported no spoilage problems associated with spices or their mixes on storage. Among the consumers who faced problems with storage of some spices, insect infestation (16.1%) and fungal growth (16.1%) were the most common problems encountered, followed by caking (12.2%), development of off color (9.4%) and off odor (5.6%). In the low-income group, spices were purchased as and when

required in very small quantities (just enough for a particular recipe). Therefore storage and the associated problems were not faced by this group. However in the middle and high income groups, traditional methods played an important role in preservation of spices, such that the participants purchased unbranded spices from the local grocers annually in the summer, then cleaned, roasted and safely packaged them in clay or glass containers which acted as the main stock. From this a small quantity, perhaps enough for the month was taken out keeping in mind hygiene norms (avoiding use of wet spoons or wet hands, packing in air tight jars, etc) and used daily for cooking. This practice amongst the consumers was particularly true for the whole spices (which were later ground) for example chilli, turmeric, coriander and cumin.

Small Cardamom powder was stored in a glass or plastic container but all the other individual spices were stored in plastic containers only. Besides refrigerating whole ginger, its paste and ground garlic, all the participants stored the other individual spices at room temperature. None of the participants reported any storage problem in most of the spices except insect infestation in whole cumin and coriander, black spots in whole garlic, off color in powdered asafoetida and off color and caking in chilli powder

The participants reported to have stored most of the spices e.g.Pav Bhaji, Sambar, Chole, Rasam, Pani puri, Jaljira, Vegetable Biryani Mix etc. in the original packaging in which they were purchased (either plastic or metallised sheet packet or more commonly the cardboard carton). On the other hand, Meat, Fish Masala and the more traditional, region specific spice mixes like Ghati, Amti, Kada, Goda, Bottle and Mix Masala were stored in glass containers. Plastic containers were used for Ginger-Garlic Paste Coriander-Cumin Powder and Jaiphal Cardamom Mix. Kitchen King and Garam Masala were usually kept in plastic containers or in the original packaging in which they were purchased while Green Masala was kept in a plastic or glass container. The most commonly used packaging for spices mixes are the cardboard cartons which are least expensive, coated with wax on the outer side to enhance the resistance to water and a polyethylene coating inside to give it additional protection and better heat sealability (Pruthi 1980). Despite this, the inadequate physical structure of cardboard cartons due to the imprudent gaps between the flaps at the corners of the box (due to improper sealing), make it highly incompetent and susceptible to insect attack. The participants stated that unlike spices, many spice mixes like Pav Bhaji, Sambar, Chole, Rasam, Pani puri, Jaljira, Vegetable, Biryani, Usal, Kada, Chicken, Tava, Rajmah, Tandoor and Chaat Masalas were refrigerated. However the participants reported to store Kitchen King Masala and Pulav Mix both under refrigeration and at room temperature and all the other above tabulated spice mixes at room temperature. No storage problem was reported by the participants except off color in Biryani Masala.

Exploration of the awareness levels of the participants on these topics revealed that the participants (especially from the low and middle-income groups) were not aware of the influence of seasonal variation, handling practices, or packaging material on the shelf life of spices and spice mixes (Refer Table.4). Across all the income groups, only 33.3%, 45.6% and 27.8% of the participants rightly thought that the shelf life of spices was influenced by seasonal variation, handling practices or packaging material respectively.

Table 4: Factors Affecting the Shelf Life of Spices and Spice Mixes as Expressed by the Participants.

Factors affecting the shelf life	LIG (%)	MIG (%)	HIG (%)
Seasonal variation	28.3	31.7	40
Handling practices	31.7	30	75
Packaging material	10	20	53.3

With respect to the seasonal variation, monsoon was regarded as the problematic period for storage, while amongst the handling practices, the use of separate spoons for each spice (32.2%), avoiding wet hands or spoons (18.3%) and using air tight containers (7.8%) were reported as good handling practices. Packaging plays an important role in conservation, preservation and transport of foods from production to consumption (Mahadeviah & Gowramma1996). Paper board cartons, plastic containers, aluminum containers, glass, tin containers flexible films, are increasingly used for packaging of ground spices (Subbulakshmi & Naik M). An inappropriate package negates all beneficial effects of the best technology that may have been used (Singhal & Kulkarni 1998). Ground spices being highly sensitive to climatic variations and prone to deteriorative losses, the packaging material used for them should offer protection against physicochemical, microbiological spoilage, insect infestation, spillage, loss of volatile oils and resist the transfer of oxygen, water vapor, and light (Balasubramanyam, 1998). However in the present study, among all the participants only 59 respondents opined that packaging material influenced the shelf life of spices. Very few individuals preferred aluminum foil packaging, carton packaging, plastic packets or plastic bottles but most of the participants (n=30) preferred glass bottles for the storage of individual spice powders.

Several studies have reported in the past the poor microbial quality of spices available in the Indian market. Among the various preservation techniques tested, irradiation has been found to be the most effective means of preservation of spices and has gained importance in the past few years. It has been proved as one of the most plausible ways to kill microorganisms in spices and prolong their shelf life (Subbulakshmi G and Udipi S.2001). Safety of irradiation of foods has been well assured by various scientists. Although irradiated spices are not readily available in the Indian market, it is highly preferred for the export of spices from India. Hence it was felt important to collect information on the awareness of consumers of the present study on irradiation. Results of the survey indicated that only 10 (n=1 in the low, n=9 in the high income group) participants out of 180 were aware of irradiation. After explaining the concept of irradiation as an effective preservation technique, when the participants were asked if they would prefer to consume irradiated spices or spice mixes, majority i.e. 76.1% (i.e. within the income groups - 85 % from the low, 90% from middle and 53.3% from the high income group) still refused to consume irradiated spices or spice mixes. Majority of the participants i.e. 68.3%, 88.3% and 43.3% from the low, middle and high income groups opined that they would prefer to consume naturally preserved or treated spices and spice mixes. A small percentage of the participants however were open to trying out irradiated spices provided that the taste as well as cost were unaltered, that it was safe for consumption and also if they were provided with more information on the safety aspects of irradiation.

CONCLUSION:

Thus through the survey it was evident that the purchase of spices and spice mixes was based mostly on the cost, convenience and the concept of tradition. Though spices are preferred in the cookery for their sensory characteristics, consumers were also aware of the various therapeutic benefits of spices. However, consumers' knowledge on the processing and packaging technologies of spices was quite limited. These results suggest the need for dissemination of scientific information from laboratories to the beneficiaries and thus making them more informed of modern food technology

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NATURAL DYES FROM BOTANICAL SOURCES –A COMPENDIUM

by Dr. Ela. M. Dedhia and Dr. Anjali .Srivastava

Color publications Pvt. Ltd., Mumbai, June 2009

Since ancient times, colours extracted from plants, insects and other minerals are used to produce variety of dyed textiles. The extraction and application was cumbersome, could not produce vibrant colours. With the advent of synthetic dyes colourful textiles appeared in the market, however some of these dyes were not environmentally friendly. With the increased environmental awareness, an effort to use natural dyes has been seen. Several organisations began promoting the use of natural dyes. But natural dyes also came with its own share of problems like availability, consistency, quality, fastness properties, limitation in shades and above all genuineness about their eco-friendliness.

Eco-friendliness of the natural dyes is dependent on the agro-climatic conditions in which they are grown, the extraction process, and on the mordents used for dye fixing. Mordents are compounds containing heavy metals that aid in dye fixation. Further, altering the mordents can impart various shades to the textiles. The presence of these heavy metals in the free form is not desirable in environmentally benign products.

Apart from the above, information on the availability of natural dyes/sources for the researchers and the industry is scanty and this situation has led to tardy growth of the natural dye industry. In this pursuit, the 'Compendium of Botanical Sources of Natural Dye Sources" compiled by Dr, E. M. Dedhia and Dr. A.Srivastava is timely and useful to all those concerned with promotion of natural dyes. The compendium has listed almost 100 sources of natural dyes from Gujarat, Rajasthan and other states of India, which are important from commercial point of view.

I hope this publication will serve as source book for promotion of Natural dyes. I appreciate the efforts put in by the authors.

Dr. G.S. Nadiger
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NATURAL DYES FROM BOTANICAL SOURCES –A COMPENDIUM

by Dr. Ela. M. Dedhia and Dr. Anjali .Srivastava

Color publications Pvt. Ltd., Mumbai, June 2009

It gives me great pleasure in penning down this foreword for a great compilation done by the authors Dedhia and Srivastava. The work is truly a dedicated one and fulfills the void seen in the published literature---botanical sources of natural dyes.

The treatise takes the reader to a guided tour of the flora of different states of India, offering a pictorial view of the colour yielding plants, the extracts of which can be classified and used as natural dyes.

In this day and age, the importance of natural dyes grows with the issues and awareness of toxicity of chemical species associated with synthetic organic dyestuffs and enforcement of legislation, which comes into force from time to time.

To a user, natural dyes usage is synonymous with total safety. The authors have systematically guided the reader to the origins of these natural colours, taking help from both the 'botany' and 'geography' streams, using suitable pictures all along.

This Dedhia & Srivastava bibliography assumes importance for the professionals in the field, as it lucidly compiles the botanical sources of these natural dyes and correlates the same with the geographical distribution of the soil and the topography combined. Details of the Gujarat and Rajasthan maps are fully sketched and are juxtaposed with the rainfall, soil conditions and the plants which blossom in those areas. The authors have taken pains to interface botany with geography, soil conditions with plant growth along with textile colouration and botanical names of the various plants, which can contribute to the sources of natural dyes. More importantly, highlighting the exact area of the tree from where the dye gets extracted, be it the bark-- the stem--the leaf-- the root or the fruit, makes the entire coverage more meaningful.

Amazingly, the rich treasure hidden in these plants originating from the various sections of the plants is made to unfold in front of our eyes. The authors have taken pains to highlight the exact portion of the plant, where the natural dye is available and also the colour it can possibly generate.

This natural dyes sources bibliography gives information alphabetically starting with the botanical origins, co-relates to the geographical distribution, gives information on the plant usage and picks up the colour-producing portion contributing to the dyes, useful as natural dyes

Dedhia & Srivastava deserve to be complimented for maintaining a perfect flow in their efforts, wherein they have given an exhaustive list of references including the World Wide Web and an appendix listing the abbreviations used throughout the text. Lastly, a glossary of botanical terms would turn out to be a treat to the textile and dyestuffs students and an excellent review to any agronomist.

The book offers a glimpse to the textile processor who is looking for natural dyes, a botanist exposing him to the essence of the plant, to a pharmacist looking for medicinal values of the plants as the column in the USES heading says it all and also to an engineer explaining where to look for the potent portion of the plants.

I am delighted with the work of Dedhia & Srivastava and congratulate the duo for doing such a painstaking task by coming out with this manuscript on Compendium of botanical sources of natural dyes. I wish further efforts are taken towards bringing out additional volumes enumerating in detail botanical sources of natural dyes emanating from the plant kingdom from all other states of India.

This volume would be useful to both the printer/ dyer using natural dyes, teachers and the students alike.

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1. Extraction and in-vitro evaluation of biological activity of crude polyphenolic extracts from Indian Grapes on transformed and non-transformed stratified epithelial cells.
   Tamhankar Neha and Ibrahim Geeta

2. Value addition of food products using protein-dense safflower seed meal.
   Dhunnoo Yoshinee and Ibrahim Geeta

3. Effect of radiation processing on Sorghum malt
   Surve Aparna and Machado Perpetua

4. Assessment of calcium status of women (15-30 years) and calcium fortification of flavored milk
   Colaco Supriya Simon and Subhadra M

5. Effect of irradiation on antioxidant activity, nutritional value and sensory attributes of flaxseed meal and groundnut meal.
   Lodha Shivani and Varghese Mary

6. Development of iron fortified flavored yogurt.
   Fernandes Sweedle and Dias Nina

7. Effect of radiation processing on antioxidant activity, nutritive value and sensory attributes of full-fat rice bran and defatted sesame meal
   Das Sweety and Mitra Anuradha

8. Characterization of protein hydrolysates obtained from groundnut oilseed cake
   Fernandes Juan and Yardi Veena

9. Impact of nutrition education programme on nutrition knowledge, perception & practices of the Hockey coaches and under 19 hockey players.
   Ahuja Priyam and Varghese Mary

10. Effect of a modified PUFA intake (Omega 6 to Omega 3 Fatty acids) in the ration of 2:1 in the ketogenic diets of epileptic patients
    D'Costa Zimaida E and Hasija Vibha

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1. Role of Mothers' in their child's transition from Preschool to first standard
   Maru Dhruti and Rege Kamini

2. Opinions and awareness of never married adults (20-35years) regarding searching for a spouse through matrimonial website
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3. Employed mothers' monitoring of their children's (7-12 years) television viewing.
   Shah Amee and Divecha Rhonda

4. Evaluation of the quality of the tribal Mensa nurturing programme for gifted children by experts and the course instructors of the programme
   Tolia Charvin and Almeida Nirmala.

5. Non-Employed mothers' monitoring of their children's (7-12 years) television viewing.
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6. Evaluation of the quality of the tribal Mensa nurturing programme for gifted children by experts and the participants of the programme
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7. Quality of Diploma and certificate training programmes in counseling in Mumbai
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   Jain Namrata and Dedhia Ela

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