Health and Nutritional Status of Adolescent Girls Working in Dyeing Units

By

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Introduction

I INTRODUCTION

"Does the consumer know when he wears a a crease resistant shirt, that it was produced by exposing the poor textile worker to a dangerous environment without his/her bieng aware of it?"

----Shenai (1989).

The Indian textile industry is one of the oldest in our country. Sandoz (1986) exhorts that India is rightly considered the home of textile industry. By virtue of its age and size, its effect on the national economy has assumed considerable importance.

Talati (1985) opines that the presence of well developed textile industry was responsible for the birth of dyestuff industry in India. Dyestuff industries in India which have their origin at about the time India attained Independence have matured over the years, producing today, a wide range of important dyestuffs (Calbhai, 1985).

Seshadri (1985) points out that the Indian dyestuff industry has grown to such a level, that it not only meets the domestic demand but also exports its produce to the most technologically advanced nations in the world.

South India has always been one of the prime textile processing centres in India. It offfers a wide range of textile processing, right from composite mills to manual yarn dyeing (Krishna Kumar, 1991).

Textile industries operate in humid environment and handle a variety of organic chemicals in large amounts. There is hardly any industry which does not use chemicals and textile industry is not an exception (Chatterjee, 1989).

The introduction of many chemicals in the textile industry, where bleaching, dyeing, printing and finishing are carried out, has resulted in air-contamination especially in the immediate vicinity of the machine endangering the health of the operators (Buch, 1989).

The textile industry with its fine interplay of heat, humidity, dust, dyes and chemicals, exposes its workers to sickness and absenteeism as observed by Mukesh (1987). The chemical hazards are on the increase with the introduction of newer and more complex chemicals. Chemical agents act in three ways - local action, inhalation and indigestion. The ill-effects produced depend upon the duration of exposure, the degree of exposure and the individual susceptability (Batra, 1987).

Shenai (1989) warns that inhalation of Hydrogen sulphide and Sulphur di and trioxide have been shown to increase the incidence of coronary diseases, bring about changes in the blood chemistry and to reduce the brain's activity to exert control over muscle movement.

Other hazardous chemical fumes like dichlorobenzene, penta-chlorophenol and cresolic compounds do not create widespread air-pollution but their vapours or dust can cause injury to lungs, liver, kidneys, pancreas and depression in the central nervous system and even cancer (Doshi, 1987).

Textile processes are inevitably associated with the production of pollutants with a potentially adverse effect on the environment. Air pollution is associated with many health hazards such as bronchitis, respiratory diseases and damage to nose, eyes and lungs (Kulkharni,1991).

Textile industry is one among the many industries to have employed women workers since a long time. These women workers unlike the majority in the informal sector have been exposed to rigorous work discipline, fixed working hours and specific production norms (Bhatji, 1991).

According to Brombard (1991), the large scale employment of women and child labourers in textile industries has added to the complexity of the problem of health hazards.

Jhalani (1989) points out that women and child labourers are by nature less suited to these type of jobs and are more prone to occupational hazards when

compared to men and so these health hazards may have a significant effect on their growth and development.

To speak more specifically about adolescent girls, who are the target group of this study, they tend to be careless about taking care of their bodies and moreover according to Hardinge (1985), adolescent girls draw so liberally upon their balance of vital energy that their account stands in red. Their extravagance makes them more vulnerable to infections and other health hazards.

According to Drummond (1989) the word 'Adolescence' is synonymous with 'puberty'. Puberty refers to the maturation or growing up of the entire body, which starts at about ten or eleven for females, peaks at age twelve and gets completed by age fifteen. It is at this time the adolescent gains about 20 percent of adult height and 60 percent of adult weight.

The adolescent years are the second period of rapid rate of growth; but vary greatly for individuals

even of the same chronologic age. These years are the most active period of life. Because of the double demands of activity and growth, food needs are high and extremely important (Bourne, 1988).

According to Gopalan (1989), an area in the field of nutrition of women in India that has been sadly neglected pertains to the adolescent girls. The interest as far as nutrition studies are concerned, seems to stop with the girls of preschool or school age and to start again only when women are actually pregnant or nursing. He adds that we have hardly taken any note of the crucial phase of growth during adolescence of the "mother-to-be" who has to usher in our next generation.

The adolescent growth spurt, which represents a 'hyperanabolic' phase of growth mediated by hormonal factors and characterised by peak velocities of growth, provides a "second opportunity'for achievement offull genetic potential for growth and development, an opportunity to undo the deleterious effects of early childhood malnutrition at least as far as final adult height is concerned (Bhargava 1989).

Ghosh (1989) opines that for such higher growth velocities to actually materialise and reach their full peak, additional nutritional inputs are necessary such as increased intake of proteins, calcium, iron and other nutrients which are essential to sustain such an enhanced growth velocity over an extended period.

Nutrient needs during adolescence are influenced by elevated amounts of estrogen and progesterone in females as well as by the anabolic adrenal androgens that increase with the onset of puberty and trigger the subsequent changes in linear height, body weight and body composition. Overall increased energy needs during the adolescent years and the genetic expression as reflected by early, normal or late maturation necessitates individualizing dietary recommendations and approaches for promoting better nutritional practices and healthier life styles (Brown, 1990).

So, proper nutritional intake during the adolescent years is important for establishing good health and as a protective measure in preventing disease in later years (Anderson, 1991).

When one talks from the point of view of good health of the workers and their work output, once again nutrition plays an important role in the efficiency and welfare of the workers as adequate diets are essential for optimum work output (Kaur, 1988).

There is also a severe dearth for studies that have investigated the impact of long term employment on the nutritional status of adolescents and their health problems that are specific to the type of work done by them (Sood, 1988).

For successfully tackling the industrial health problems it is highly necessary to focus the attention on the various occupational hazards. This helps not only in the application of preventive and remedial measures but also to a better understanding of industrial health (Hariharan, 1985).

The outcome of such studies may contribute a great deal to identify the industries that may be detrimental to the health and nutritional status of adolescent girls, and suggest ways and means of preventing these health hazards.

The present study is an effort in this direction. The study is based on the following objectives:

1. To study the nutritional status of female workers employed in the dyeing units along with matched controls.
2. To study their health problems specially related to their working environment.
3. To collect details regarding the health coverage available in the units.
4. To sugggest ways and means of eliminating or reducing the health hazards.

It is hoped that the study will throw some light on the problems of adolescent workers and ways and means of reducing their health problems.

Review of Literature

II REVIEW OF LITERATURE

The review of literature pertaining to this study on 'Health and Nutritional Status of Adolescent Girls Working in Dyeing Units' is discussed under the following headings:

1. Importance of the Adolescent Age Group
2. Nutritional Status of Adolescents in India
3. Health Status of Adolescentsworking in Dyeing Units
4. Chemicals Used in the Dyeing Industry and their Effect on Human Health
5. Safety and Preventive Measures to be Followed in a Dyeing Industry

1. Importance of Adolescent Age Group

Adolescence is a period of rapid growth and development. The pattern of growth gets complicated by the variability on the onsets, duration and intensity of the pubertal growth spurt (Kapoor *et al.*, 1991).

During adolescent period, young people are passing through a physical and psychological crisis from

which they must emerge victorious. Once they have mastered their immediate problems and adopted for the future ways of life and habits of physical and mental hygiene, their full development is assured (Martin Allain, 1985).

According to Huenemam et al.,(1986),the teenagers they surveyed were keenly interested in the size and shape of their bodies and their predominant attitude was one of dissatisfaction with their weight, stature and certain body dimension.

Acording to Anuja et al., (1991), to assess the growth of the adolescents accurately only composite indices like body mass index (wt/ht2) are likely to be reliable. Based on this, the triceps skinfold thickness (TSF) was measured in healthy adolescents aged 11-18 years with the standard Harpender's skinfold calliper. Females at all age studied had thicker skinfolds than their male counterparts and showed a steady gain throughout adolescence. TSF was found to have no correlation with height but good positive correlation with weight and wt/ht2 (body mass index).

In another cross-sectional study made by Chatterjee and Mandal (1991) the mean height and weight of girls aged 9-17 years were found to gradually increase upto the age of 17. The average age at menarche was 13 years and the girls aged 13 years (currently) reached 98 percent of height and 85 percent of weight as compared to 17 year old girls.

In a similar study done by Sathyavathi et al., (1985), rural girls were significantly taller than their urban counterparts after the 10th year of age. The maximum annual increment for body weight showed gains of 3-4 kg a year and height 5-7 cm a year. The velocities were much lower than those reported for adolescents in U.K.

According to a study done by Rao et al., (1991) the mean age at maximum height increment was 12.5+ years while weight gain remained significant for following 15 years.

According to Underwood (1991) in normal adolescent girls, menarche occurs on the decending limb of the height velocity curve, but in girls with

early puberty menarche may occur at the same time or slightly before the peak height velocity.

Based on a recent study by Leela Raman (1990) there does seem to be a trend towards a decrease in the age at menarche over the decades both in the rural and urban situations, not only in the affluent upper classes but also among the poor classes of urban and rural communities. The decrease in age at menarche while indicting the improvement in the socio-economic, educational and cultural scenario has its own disadvantage especially among the poor and rural illiterate adolescent population making them prone to numerous nutritional deficiencies.

According to Kanade et al., (1989) marked individual differences are encountered in the onset and magnitude of adolescent growth spurt. Often these individual differences are attributed to socio-economic factors, or to the nutritional factors or to the malnutrition in the early childhood.

According to Peacock (1991) with the onset of puberty and adolescence, the rate of growth again accelerates, peaks and then decelerates until longitudinal growth is complete. All tissues are involved in growth and none more so than the skeleton. From birth to puberty it increased by about seven fold and by a further 3 fold during adolescence.

According to Witschi *et al.*, (1990), the eating habits of adolescents are reflected in their growth pattern, as well as in their physical appearance ie. height, weight and relative signs of fat and lean mass compartments.

Lacey *et al.*, (1985) and Durnice *et al.*, (1985) have reported marked daily variations in dietary intake among adolescent girls.

According to a study carried out by Sarojini and Vijayalakshmi (1989), adolescent girls with moderate and heavy activity were provided with the diets planned as per the RDA by the ICMR. The subjects with moderate activity consumed less

amounts of all foods than the subjects with heavy activity. So, activity pattern also has its effect on the dietary consumption of adolescents,

So, as per Anderson (1991), proper nutritional intake during the adolescent years is important for establishing good health, growth and as a factor in preventing disease in later years especially in women.

2. Nutritional Status of Adolescents

Nutritional requirements like iron, calcium and vitamin B complex, increae significantly to meet the demands of the rapid growth, during adolescence, (Fidanza et al., 1988). According to Leela Raman (1990), the adolescent girls, who have attained menarche at an earlier age, are more prone to developing anaemia and nutritional deficiency signs. Other nutritional deficiency symptoms especially off B-complex vitamins (angular stamatitis and glossitis) are more common in poor classes because of the poor quality of the diet.

The food intake of adolescent girls was recorded and analysed for nutrient content. Daily

energy intake was 300-500 k.cal less than the RDA by ICMR (Chandana and Bhat (1985).

According to Forbes (1991) low energy diets in adolescents lead to weight loss, of which a portion is lean tissue. Generally speaking the degree of weight loss is proportional to the energy deficit.

According to a study done by Pushpamma et al., (1985), the intake of all foods were low except cereals. The requirements of Vitamin C, A and B-complex were most inadequately met. The requirements for energy, protein and niacin were met only upto 80-85 percent. Iron intake was only 62 percent of the requirement.

According to Woodward (1985) fatter and heavier girls, were less likely to have high intakes of carbohydrates, iron and niacin equivalent and also of meat and empty energy foods. Girls from small families were less likely to have high calcium intakes and girls from government schools less likely to have high thiamin levels.

According to Kenney (1985), girls, with low ferritin concentration were leaner and ingested more calcium and less vitamin C than those with adeuqate stores.

One of the major causes for anaemia next to iron deficiency is folacin deficiency. The folacin status of 103 adolescent females aged 12-16 was evaluated by Clark et al., (1987), Serum folacin levels and dietary folacin intake decreases with increase in age Farthing,(1991),the overall low intake of fresh fruits and vegetables confirmed the previously observed low folacin state of young people (Bailey,1985).

According to Peacock (1991), adolescents are not absorbing sufficient calcium to achieve maximal bone mass. Mathovic (1991) warns that many female adolescents may be at increased risk for the development of skeletal inadequacy due to the imbalance between calcium intake and the high requirements leading to the low peak bone mass and therefore osteoporosis later on in life.

Another reason for this calcium deficiency is inadequate vitamin D, as this vitamin is necessary

for the absorption of calcium. According to O'Hare (1985), vitamin D deficiency was most noticeable in girls of 13-15 years age and biochemical rickets occured in six percent of those adolescents. If vitamin D requirements are not met during the physiological growth spurt, permanent pelvic deformity may result. These findings support the need for Vitamin D and it is suggested that adequate vitamin D supplements by mouth would alleviate the problem (Kagamimori, 1989).

Sloane et al., (1985) in his study on the zinc and coppeer nutritional status and effects upon growth of adolescent females found that the plasma copper levels were positively related to body size (p. 0.05). The mean plasma zinc was found to be 83± 15 ug/dl.

Adolescence is characterised by major physiological changes that increase nutritional needs and unusual, often irregular, eating habits. These factors may place individuals at risk of pantothenic acid deficiency (Eissentat, 1986).

Medium intakes of fat, iron, thiamin and niacin equivalent were lower in heavier, fatter girls. Girls from larger families ate more riboflavin while those with poor educated mothers ate less vitamin A. Girls who regularly took vitamin supplements had greater median intakes of dietary calcium (Joshi, et al., 1989).

Growth studies have shown a close relationship between growth in height and protein intake during specific periods such as adolescence. Protein tends to average 12-16 percentage of total energy intake during adolescence, with 15 percent appearing to be optimal (Lyons, 1989).

3. Health Status of Adolescent Girls Working in Dyeing Units

"Health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity" --WHO(1986).

Health does not exist in isolation. It is influenced by a complex of genetic, environmental, social and economic factors related to each other (Park and Park, 1986).

The complex relationship of the dyeing worker with her working and living environment generates strains and tensions in many dimensions, most of which have a direct or indirect bearing on her physical and mental health (Mukesh, 1987).

Occupational health therefore aims at the highest degree of physical, mental and social well being of the workers, and attempts to maximise his efficiency and prevent losses resulting from absenteeism (Bhatra, 1984).

The joint ILO/WHO Committee (1950) defines occupational health as follows:

"Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation, the prevention among workers of increasing ill health caused by their working conditons, the protection of workers in their employement from risks resulting from factors adverse to health, the planning and maintenance of the worker in an occupational environment adopted to his physiological and psychological equipment

and to summarise the adaptation of work to man and of each man to his job".

Rao (1991) points out that industrial workers constitute only a segment of the general population and the factors that influence the health of the population also apply equally to industrial workers ie. housing, water, sewage and waste disposal, nutrition and education. In addition to these factors, the health of the industrial workers in a large measure, will also be influenced by conditions prevailing in their work place.

One of the declared aims of occupational health is to provide a safe occupational environment in order to safeguard the health of the workers and to step an industrial production (Dastur, 1986).

The scientific and technological revolution has brought greatchanges in both the nature and the condition of dyeing work. However, progress and modernization often bring in their wake dangers for workers health (Trivedy, 1985).

According to Saraf (1986), a dyeing worker faces the following hazards namely: physical, chemical, biological, mechanical and psychological hazards. The physical factors in the working environment

environment which may be adverse to the health of the dyeing workers are heat, cold, humidity, air movement, light, and noise (Bhattacharya, 1985). The direct effect of heat exposure are bruns, heat cramps and heat exhaustion. The indirect effects are decreased efficiency, increased fatigue and enhanced accident rates. A temperature between 20 -27 °C could be well tolerated.(Goel, 1985).

The dyeing worker may either be exposed to bright light or poor light. The acute effects of poor lighting are eye strain, headache and watering of eyes. Exposure to excessive brightnes is associated with discomfort, annoyance, visual fatigue and in some cases blurring of vision (Chand, 1989).

Dye industry is the force behind the increased use of colour which is nothing but chemicals in every facet of our life and so chemical hazards are the most commonest in the dyeing industries (Kumar, 1991)

There has been a tremendous spurt in the production of chemicals and the end products into which they go eventually, resulting in the manufacture of products which appear attractive but which are injurious to human helath (Raghavan, 1985).

Chemical agents act in three ways: local action, inhalation and ingestion. The ill effects produced depend upon the duration of exposure, the quantum of exposure and individual susceptibility (Lakshmikanthan, 1983).

Biological hazards are also present in dyeing industry as they are exposed to infective and parasitic agents at the place of work. The mechanical hazards in dyeing industries center around machinery, protruding and moving parts and the like. Psycho-social hazards in the dyeing industry arise from the worker's failure to adjust themselves to a different environment (Park and Park, 1986).

Psychological and behavioural changes include hostility, depression and alcoholism. Psychosomatic

illness includes fatigue, headache, pain in the shoulders, peptic ulcers, high blood pressure, heart disease and rapid ageing. Physical factors like heat, noise, light etc. also play a major role in precipitating mental disorder among workers (Hariharan, 1985).

Patwardhan (1989) opines that in most developing countries malnutrition is an important factor contributing to poor health among workers and low work output. Malnutrition also lowers the tolerance level of an individual and an under-nourished worker is more prone to occupational diseases.

A deficiency of specific nutrients, for instance, may allow toxins to produce severe damage to our cells by process called free radical oxidation. The toxins accumulate and symptoms such as allergies, fatigue and skin problems appear (Chaitow, 1990).

So, as Ramadasmurthy (1983) rightly puts forth industrial workers constitute a vital segment in view of their significant contribution to the

national income and their working efficiency and output in turn are very much dependent on the health and physical fitness of the individuals. Therefore adequate measures have to be taken to improve the health status of the industrial workers.

4. Chemicals Used in the Dyeing Industries and the Resulting Health Hazards

What once used to be "chemical development" has turned into a "Chemical revolution" and is now well on the way of becoming chemical chaos". Too many substances and compounds are entering our homes, our working place, our environment and our bodies without our really knowing their risks and benefits, without a true evaluation of their influence and worse still without complete studies of their harmlessness for other forms of life (Jenny, 1990).

The chemical constitution of dye are so varied that it is difficult to classify them into distinct groups. The colour index classifies dyes as follows: Nitroso, nitro, azo, azoic, stilbene, diarylmethane, triarylmethane, xanthene, quinoline, methine, acridine, sulphur, thiazoli, thiazine, indamine, azine, oxazine, lactone, anthraquinone, indigoid and phthalocyanine (Finar, 1986) who are in close contact with these dyes. Dyestuff chemists say, there are

there are as many as 4000 different dyes or combination of dyes being made and used today (Lyle, 1982).

The dyeing workers are therefore exposed to many toxic chemicals and dyes besides occupational injuries to lungs and hearing (Brombard, 1991).

Dyeing involves the use of corrosive acids like hydrochloric, sulphuric, nitric, acetic and phosphoric acids. Corrosive burns result from skin contact, from the inhalation of fumes and from the ingestion of strong acids (Prasad, 1990).

Prolonged exposure to low concentration of Hydrochloric acid causes erosion of teeth. Mists containing hydrogen chloride can cause bleeding of the nose and gums, ulceration of the nasal and oral mucosa and render the skin of the face very tender (Buch, 1989).

Pillai (1984) warns that the associated health hazard in the use of acetic acid vapours can be divided as acute and chronic disorders. In the acute forms it leads to skin irritation and reduces chemical burns and blisters and particularly

irritation to the exposed mucous membranes Of conjunctiva, upper respiratory tract and nasophayrynx. In the chronic form it leads to digestive disorders, pyorrhoea, chronic pharyngitis, coatorrhal bronchitis and asthamatic bronchitis.

Formaldehyde is a chemical which is capable of causing skin rashes, nausea and menstrual irregularities Shah (1986) ; Chaitow (1990).

Many dye ing industries use hypochloride solution for bleaching; in others the bleaching agent is gaseous chlorine or bleaching powder from which chlorine is evolved when it is charged into the tank. In either case, workers may be exposed to a dangerous atmosphere unless precautions are taken. Chlorine is a skin and eye irritant and a dangerous pulmonary tissue irritant causing delayed lung oedema (Parmeggiani, 1990).

According to Bloomfield (1990) Hydrogen peroxide which is used in bleaching and dyeing in large doses produce esophagitis and gastritis, cases of rupture of the colon, and ulcerative colitis have also been reported.

According to Gore (1984) Nitrogen dioxide which is used in dyeing is also a pollutant. The odour can be detected by the human nose and it acts as a mild irritant to the exposed mucous membranes.

Dichloro benzene which is used in the dyeing of polyester fibre fabrics is another pollutant. The toxicological effect of this is that it is primarily injurious to the liver and secondarily to the kidneys. Short-exposure at high concentration may result in depression of the central nervous system (Shenai,1989).

According to Shryock (1985) alkali burns are the most hazardous among the chemical burns. Sodium hydroxide and ammonia are used in dyeing and printing and these are hazardous for the tissues of the cornea as it contains no protection against the tissue-destroying effects of alkali.

Kay (1989) had identified three areas which should be considered in evaluating the overall cancer risk of dyes.

- dye manufacture and dye application
- inhalation of dyed fibre bits
- skin absorption factor from skin contact with dyes

The increased risk of cancer was attributed to naphthlamine, benzidine and 4-aminodiphenyl. It was confirmed that higher than normal incidences of bladder cancer were present among dye-exposed workers in primary production and among the users of dyestuffs (Bhokare, 1988).

Aniline is used extensively in textile industry for dyeing of jet black shades by oxidation methods. Aniline and its related compounds may gain access to the body through the skin, by ingestion or by inhalation. Aniline produced blood poisoning accompanied by cyanosis. Cancer of the bladder occurs after long years of working in an aniline plant and is generally not detected in the early stages (Prasad, 1990).

Statistics now show that nearly 75 percent of occupational cancers are skin cancers. It was subsequently found that cancer of the scrotum and of the skin in other parts of the body was caused by dyes and so is a major occupational hazard among dye workers along with others who work with mineral oil, pitch, tar and x-rays (Parmeggiani, 1990).

Benzidine is a chemical which is involved in the production of direct dyes. The hazards of producing and using this class of products is the carcinogenous nature of benzidine (Doshi et al., 1985).

Occupational dermatitis is a big health problem in many industries of which dyestufff and dyeing industry is one (Bharve et al., 1985). Dermatophyte infection is found in persons working in bleaching department due to continuous contact with wet floor. This infection is transmitted to the webs of toes and gets a chance to grow if the toes are not kept clean and dry (Hariharan, 1985).

So, as Izmerov (1989) rightly points out that it is high time for the owners and management of textile processing units and the government to execute/adopt precautionary measure to avoid the harmful effects of the risk prone chemicals to human health.

5. Safety and Preventive Measure in Dyeing Industries

"Our planet - Our health; Think globally - act locally". If we act according to the slogan of world Health Day 1990 we can manage to reverse the present negative trends and to secure the resources to sustain a healthy environment for the present generation and for those to come (Jenny, 1990). Safety can be defined as a positive organized activity based on knowledge of the reaction between man and his working environment (Subbiah, 1991).

The union government has formulated a model scheme, known as Safety and Health Accident Reduction Action Plan which is an integral part of the wider national plan for coordinated action to enforce safety in chemical and other hazardous industries. According to Sharma (1987), P.A Saugma (1986), every chemical industry should have in-built safety measures which in the final analysis would prove cheaper and go a long way in eliminating accidents.

According to Varadarajan (1986), a safety organisation is vital in each chemical industry in addition to designated safety officers. It will have to improve safety through training, inspection, education, provision of equipment and recording of safety performances. Many of the chemical accidents are associated with the inadequate knowledge of the chemicals in hand, its toxicity, its storage etc. (Abhyankar, 1989).

According to Varadhan (1989), hazardous chemicals of alleged toxicity, now are claimed to exist at a level of per billion range. He says that the best way of tackling problems with regard to hazards faced by the textile workers would be to adopt a rational approach by identifying problem areas, based on realistic and fair test methods for assessment of specific toxic risks, biodegradability, and free residual concentrations of chemicals, in fibres, effluent and the like, whilst the textile industry for its own part, should do its best to minimize pollution by adhering to processing parameters best constituted to achieve this.

Nadkarni (1985) and Mehra (1985) warn that chemical industry is the greatest pollutant of modern times. There are some obnoxious gases coming out during the chemical processing of textiles, but if due care is taken with the help of special chemicals and by maintaining proper conditions and special exhaust range, the ill effects of the gases could be minimised.

In order to produce a safe working environment the following methods have to be followed according to Prasad (1990).

a) substitute a non-toxic substance for a dangerous substance
b) isolation and automation of the dusty process so that none of the workers are exposed
c) enclosure of machinery, so that little dust escapes into the atmosphere
d) wetting or dampening the dusty process
e) various methods of exhaust ventilation to remove dust from the working environment

Mathur (1991) advises that protective or functional clothing is essential specially in areas where there is contact with potentially dangerous chemicals.

Goggles or face shields are advisable to protect the eyes and face against vapours, dust and splashes of chemicals. A respirator is strongly recommended to prevent inhalation of dust, powders and sprays. According to Luigi (1990) personal hygiene is particularly important for dyeing workers. Protective clothing that is splashed or contaminated by dyestuffs should be replaced by clean clothing at the earliest opportunity; sanitary facilities for washing and bathing should be provided and the workers should be encouraged to use them to ensure their personal hygiene.

According to Shah (1990) the physicians in the textile industry must find in what areas the hazard is greatest and lay continued surveillance to maintain the health of the exposed population. Repeated medical examination of workers with appropriate lung or other tests must be done and the results correlated with the amount of toxic substance in the atmosphere.

According to Williams (1990) the co-operation of the textile worker is essential to protect himself from the chemical hazards. He must submit to medical examination and be prepared to use personal protection in certain circumstances.

As per Varadarajan's (1986) words "Life and health of every living human being are precious and all steps should be taken by all concerned to ensure that all knowledge is brought to bear collectively to forsee problems and find solution".

Methodology

III METHODOLOGY

The experimental procedure pertaining to the study on 'Health and Nutritional Status of Adolescent girls Working in Dyeing Units' is discussed under the following headings;

1. Selection of the Area and Venue
2. Selection of the Sample
3. Selection of the Tool
4. Conducting the Study
5. Analysis of the Data

1. Selection of the Area and Venue:

The area selected for the study was Karur Taluk in Trichy District, Tamil Nadu. Trichy district is one among the five renowned districts in Tamil Nadu which have made their own name for yarn dyeing, woven fabrics,printed and dyed fabrics, and hosiery knitted fabrics (Kumar, 1991). The other four districts being Salem, Periyar, Madurai and Coimbatore.

During the last one and a half decade, the people of Tamil Nadu, particularly from the districts of

Salem,Periyar,Coimbatore,Trichy and Madurai have put up their names on the map of not only India but also that of the world and are doing a roaring business, concentrating mainly on cellulosic fabrics and the stress is more on dyeing than on printing (Mohindra, 1991).

In Karur, there were 670 dyeing units which were categorized based on their size as large, medium and small sized dyeing units. For this study 30 small sized dyeing units and 10 medium sized dyeing units making a total of 40 units were selected for drawing the required number of adolescent female workers in the dyeing units.

Karur was considered the most potential area for the study by virtue of the fact that female adolescents, the target group of the study are being employed in large numbers only in Karur when compared to the other places.

2. Selection of the Sample:

The sample selected for the study was adolescent girls working in dyeing units coming under the age group of 13 - 18 years. The adolescent girls for the study were selected based on the following criteria:

a) The adolescent girls who were selected were working in the dyeing unit for a minimum period of three to six years.

b) All the adolescent girls chosen for the study were actually involved in the dyeing work.

Based on these two criteria five adolescent girls were selected from each of the forty dyeing units chosen for the study. This worked out to a total of 200 adolescent girls working in the dyeing units.

Forty adolescent girls with similar socio-economic background and dietary habits were chosen randomly to serve as controls for this study in the same area namely Karur in Tiruchi District.

3. Selection of the Tool;;

Interview schedule was chosen as the tool to collect information from the adolescent girls working in the dyeing units. With the help of this interview schedule the following details were collected:

a) Family background

b) Details regarding their job

c) Health problems

d) Health coverage available within the dyeing unit

e) Hygienic practices adopted

The detailed interview schedule evolved is presented in Appendix-I.

Interview schedule is a verbal method of securing data. It involves a person designated the interviewer asking questions (mostly) in a face-to-face contact (generally) to the other person or persons, designated the interviewee/s who give answers (mostly) to these questions (Gupta, 1990).

This technique was particularly selected as it is said to be one of the most commonly and effectively used techniques of data collection in human studies (Wilkinson et al., 1984).

Since this was a face to face questioning and answering type at the workplace itself accurate information were gathered and recorded then and there.

4. Conducting the Study:

The conduct of the study consisted of the following steps:

a) Recording heights and weights
b) Conducting clinical examination
c) Carrying out selected bio/chemical tests
d) Carrying out selected urine tests and
e) Recording the dietary intake by 24-hour recall survey method

a) Recording Heights and Weights:

The heights and weights were taken at the beginning of the study for experimental as well as control groups.

i) Recording Heights:

The heights of the experimental and control groups were measured with the help of a non stretchable measuring tape, capable of measuring to an accuracy of 0.25cm following the method recommended by Jelliffe (1966).

The non-stretchable measuring tape was fixed to the wall and the girls were asked to stand on a flat floor by the tape after removing their slippers and with heels, buttocks, shoulders and back of head in line. The hands were made to hang at the sides in a natural manner and the head held comfortably erect. Instead of the headpiece, a wooden scale was used in this study which was gently lowered, crushing the hair, and making contact with the top of the head.

ii Recording Weights:

The weights of the control and experimental group were recorded using abathroom scale capable of reading nearest to 500 grams.

While recording the weight of the adolescent girls the guidelines laid down by Jelliffe (1966) were followed as far as possible. The adolescent girls were made to stand on the centre of the scale without touching anything else. Slipper were removed and minimum clothing worn at the time of weighing.

b) Conducting clinical examination

The experimental and the control group of adolescent girls were examined for signs and symptoms that suggest nutritional deficiency with the assistance of a medical practitioner at their place of work itself. The girls were examined for protein energy malnutrition, vitamin-A deficiency, vitamin B_1 and B2 deficiency and vitamin C deficiency signs with the help of a proforma.

The proforma used for the clinical examination is given in Appendix - II.

According to Robinson (1986) by being an observant, a nurse, teacher or nutritionist can detect many signs in children, adolescents, and adults that suggest the possibility of nutritional deficiency and can hasten referral to a physician for diagnosis.

c) Carrying out selected biochemical tests

A sub-sample of 35 adolescent girls working in the dyeing units along with 35 girls from the control group were chosen for carrying out the biochemical tests.

According to Brown (1990) with selected biochemical tests, deficiencies or excesses can be detected before symptoms are apparent thus making it possible to institute early nutritional corrections.

For the present study whole blood samples of the adolescent girls in both control and experimental groups were used for carrying out the biochemical tests. Blood samples were obtained from the subjects by finger prick method and were subjected to the following tests. Procedure given in Appendix III.

i) Haemoglobin:

The cyanmethaemoglobin method was adopted for determining the haemoglobin content. This method is recommended by Varley (1988) for its accuracy and reproducability. 0.02 ml of blood was drawn from the finger tip of each adolescent girl for carrying out this test.

ii) Red blood cell count:

For estimating the red blood cell count, 0.5ml of blood was drawn from the finger tip with the help of improved Neubauer haemocytometer, placed on a counting

chamber and viewed through the microscope for counting. . Counting was carefully done by counting the cells in the 80 small squares, 5 groups of 16 in the central ruled area (Chatterjee, 1987).

iii) Differential leukocyte count:

This test was carried out with the preparation of a blood smear with one or two drops of blood drawn from the finger tip. The blood smear was then microscopically examined for the presence of polymorphs, eosinophils and lymphocytes (Tietz 1989).

Carrying out selected urine tests :

Two hundred ml of the early morning urine was obtained from the adolescent girls and tested for the presence of sugar, albumin, acetone and other elements like epithelial cells, leukocytes (pus cells) and erythrocytes, following the methods recommended by Varley (1988). Procedure given in Appendix IV.

i) Sugar

Presence of sugar in urine was tested using Benedict's qualitative test which is based on the reducing action of sugars. The colour change from yellowish green to red was used as the indicator for testing the presence of sugar.

ii) Albumin

Bence-Jones qualitative test for protein was carried out for testing the presence of albumin, a plasma protein, in urine.

iii) Acetone

Rothera's Nitropruside qualitative test for acetone and diacetic acid was done for the testing the presence of acetone in urine.

iv) Microscopic examination of the urine deposits for the presence of pus cells, erythrocytes and epithelial cells:

Microscopic examination of urine is of great importance and should never be omitted (Varley, 1988). Early morning urine was centrifuged and the urine deposits were mounted on a microscope and examined for the presence of pus cells, erythrocytes and epithelial cells.

d) Dietary survey by 24-hour recall method :

Dietary study may be brief or detailed depending upon the purpose for which it is intended.

24-hour recall method is the most widely used dietary survey method on which subsequent dietary counselling is based. The client recalls food intake for the preceding 24 hours by interview or by completing a questionnaire. If this method is used together with a food frequency study or cross check, the 24-hour intake is a more useful tool (Bourne,1988).

In this study a sub-sample of fifteen adolescent dyeing workers along with matched controls were asked to recall the food items consumed for the preceding 24 hours by interview. Other related details like the amount of food eaten in terms of cups and numbers, the method of preparation and the time of consumption were also recorded.

5. Analysis of the Data:

The collected data was consolidated, statistically analysed and the results obtained are presented in the next chapter.

Results and Discussion

IV RESULTS AND DISCUSSION

The data collected for this study on "Health and Nutritional Status of Adolescent Girls Working in the Dyeing Units" are discussed under the following headings:

1. General Information of the Adolescent Girls

   A. Details Regarding the Dyeing Units in Karur Distribution, Classification and Selection
   B. Background Information Regarding the adolescent Girls
   C. Details Regarding the Nature of Job of the Adolescent Girls Working in the Dyeing Units

2. Health Problems of the Adolescent Girls

   A. Gastro-intestinal Problems
   B. Skin Problems
   C. Respiratory Problems
   D. Menstrual Problems
   E. Other Health Problems
   F. Impact of Health Problems on the Working Pattern of Adolescent Girls

3. Protective Measures Available in the Dyeing Units to Combat Health Problems

A. Health Coverage Available in the Dyeing Units

B. Protective Aids Provided and Used by the Adolescent Girls Working in the Dyeing Units

C. Hygienic Practices Followed by the Adolescent Girls Working in the Dyeing Units

4. Nutritional Status of the Adolescent Girls

A. Mean Heights and Weights of the Adolescent Girls

B. Findings Based on the Clinical Examination of the Adolescent Girls

C. Findings Based on the Urine and Blood Examination of the Adolescent Girls

D. Mean Food and Nutrient Intake of the Adolescent Girls

1. General Information of the Adolescent Girls

A. Details Regarding the Dyeing Units in Karur

Distribution, Classification and Selection:

Table I gives the details regarding the dyeing units in Karur.

TABLE I

DETAILS REGARDING THE DYEING UNITS

S.No	Nature of the dyeing units	N	Percent
1.	Small sized units	350	52
2.	Medium sized units	120	18
3.	Large sized units	200	30
	Total	670	100

Asis evident from Table - I Karur Taluk has on the whole 670 dyeing units out of which 52 percent were small in size, 30 percent large and 18 percent medium in size. The size of the units was based on the number of workers employed in the unit.

The investigator selected 30 small dyeing units and 10 medium dyeing units for carrying out the present study from among the existing 670 dyeing units. Selection of these units was based on the co-operation and willingness of the owners of the units to allow the investigator to carry out the study. Figure 1 shows the distribution of dyeing units in Karur Taluk and the areas selected for the present study.

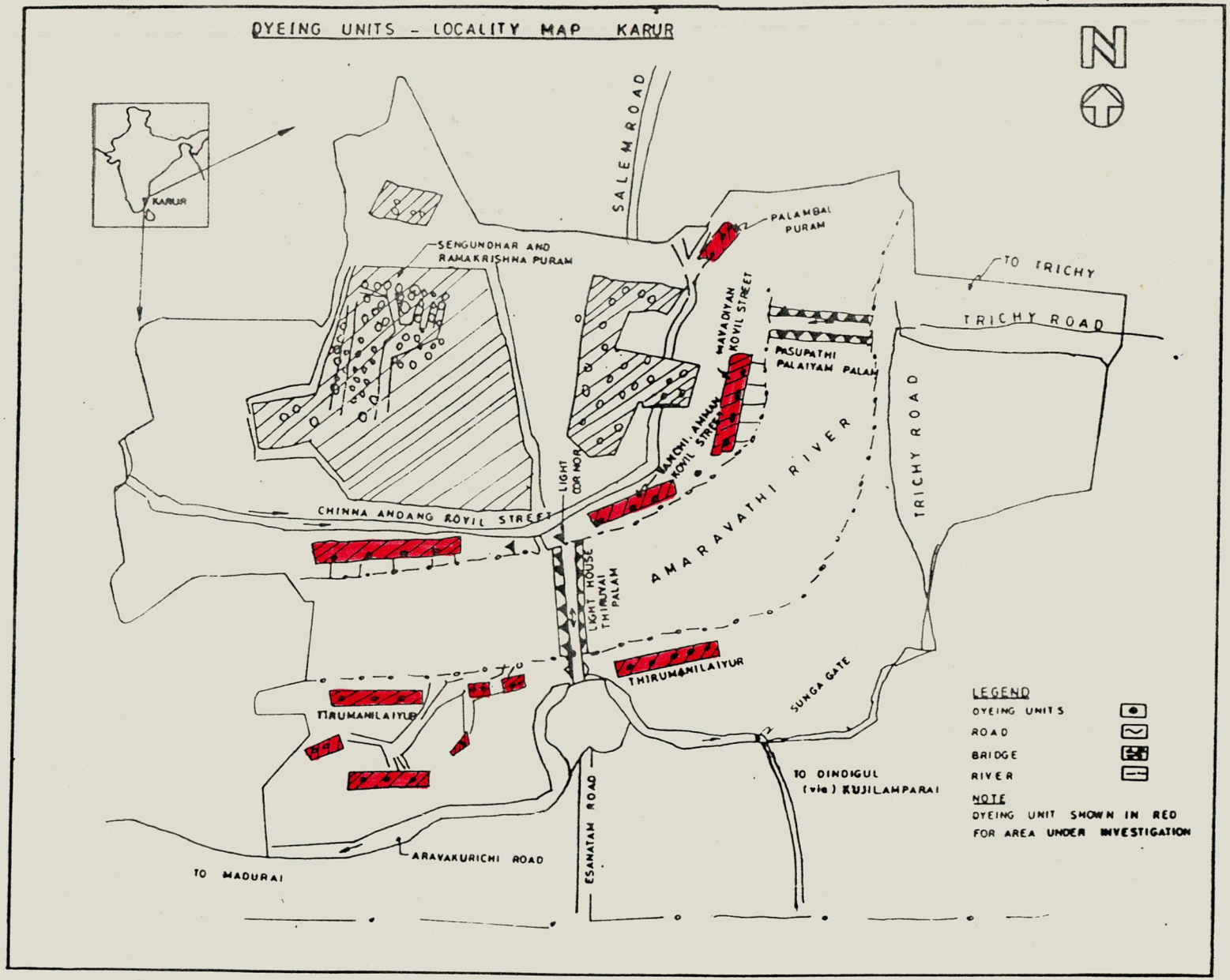

DYEING UNITS - LOCALITY MAP KARUR
N
KARUR
SALEM ROAD
SENGUNDHAR AND RAMAKRISHNA PURAM
PALAMBAL PURAM
TO TRICHY
TRICHY ROAD
MAYADIYAN KOVIL STREET
PASUPATHI PALAIYAM PALAM
TRICHY ROAD
AMARAVATHI RIVER
LIGHT COR NOR
KAMCHI AMMAN KOVIL STREET
CHINNA ANDANG KOVIL STREET
LIGHT HOUSE THIRUVAI PALAM
THIRUMANILAIYUR
SUNGA GATE
TIRUMANILAIYUR
TO DINDIGUL (via) KUJILAMPARAI
ESANATAM ROAD
ARAVAKURICHI ROAD
TO MADURAI
LEGEND
DYEING UNITS
ROAD
BRIDGE
RIVER
NOTE
DYEING UNIT SHOWN IN RED FOR AREA UNDER INVESTIGATION

FIGURE - 1

B. Background Information Regarding the Adolescent Girls

Table II gives details regarding the age and educational status of the girls in the experimental group)Group A and Control Group (Group B).

TABLE II

DETAILS REGARDING AGE AND EDUCATIONAL STATUS

S.No	General information	Group A *		Group B**	
		N	Percent	N	Percent
1	Age Group				
	13 to 15 years	64	32	27	67
	16 to 18 years	136	·68	13	33
	Total	200	100	40	100
2.	Educational Status				
	Illiterate	2.0	1.0	4.0	10
	Primary School	189	94.5	30	75
	Middle School	9.0	4.5	6.0	15
	High School	Nil	Nil	Nil	Nil
	Total	200	100	40	100

*Group-A denotes adolescent girls working in dyeing units

**Group-B denotes adolescent girls not working.

Table II shows that, out of the 200 adolescent girls working in the dyeing units 32 percent belonged to the age group of 13 to 15 years and 68 percent belonged to the age group of 16 to 18 years. In group B 67 percent belonged to the age group of 13 to 15 years and 33 percent belonged to the age group of 16 to 18 years.

A study of their educational background revealed that none of the adolescent girls had studied beyond the middle school level and a majority of 94.5 percent from group A and 75 percent from group B had studied only upto primary school level.

Table III gives the details regarding their family background and income.

TABLE III

DETAILS REGARDING THE FAMILY

S.No	Family details	Group A		Group B	
		N	Percent	N	Percent
1.	Type of family				
	Joint	29	15	Nil	Nil
	Nuclear	171	85	40	100
	Total	200	100	40	100
2.	Number of Members				
	3 - 4	65	32	16	40
	5 - 6	125	63	22	55
	7 and above	10	5	2	5
	Total	200	100	40	100
3.	Monthly percapita income (in rupees)				
	200 - 250	27.0	14.0	4.0	10.0
	251 - 300	165.0	82.0	31.0	77.5
	301 - 350	5.0	2.5	4.0	10.0
	351 - 400	3.0	1.5	1.0	2.5
	Total	200	100	40	100

It is clear from Table III that 85 percent and 100 percent of the families from Group A and B respectively were nuclear in nature. Only 15 percent of the families from group B belonged to the joint families.

It was encouraging to note that the family size of these adolescent girls was relatively small, both in group A and B.

Sixty three percent from group A and 55 percent from group B had a family size of five to six which included the parents also. Thirty two percent of group A and 40 percent of the group B had a familuy size of only three to four and only 5 percent in each of the groups A and B had a family size of seven and above.

Eighty two percent of the families of group A and 77.5 percent of the families of group B had a per capita income of only 251-300 rupees, in a month. While 2.5 percent of the group A families and 10 percent of the group B families had a percapita income of 300-350 rupees, 14 percent of group A and 10 percent of the group B families had a percapita income of only 200-250 rupees. It was very sad to note that only 1.5 percent of group A and 2.5 percent

of the group B families had a per capita income of above 351-400 rupees per month.

C. Details Regarding The Nature of Job of the Adolescent Girls Working in the Dyeing Units:

Table IV presents the details regarding the nature of job of the adolescent girls working in the dyeing units.

TABLE IV

JOB DETAILS OF THE DYEING WORKERS

S.No.	Job details		Group A	
			N	Percent
1.	Years of experience			
	Less than 3 years		Nil	Nil
	3 - 4 Years		104	52
	5 - 6 years		81	40
	7 - 8 years		15	8
		Total	200	100
2.	Number of working hours per day			
	Below 8 hours		7	3
	8 hours		70	35
	9 hours		67	34
	10 hours		50	25
	Above 10 hours		6	3
		Total	200	100
3.	Type of work done			
	Light		36	18
	Moderate		164	82
	Heavy		Nil	Nil
		Total	200	100
4.	Income per month (in rupees)			
	300 - 500		23	11
	501 - 700		55	23
	701 - 900		114	57
	901 and above		8	4
		Total	200	100

Table IV reveals that 52 percent of the adolescent girls had a minimum experience of three to four years in the dyeing units while 40 percent had five to six years experience and only 8 percent had seven to eight years of experience. Only those who had put in a minimum of three to four years experience were included in the study so that the health and the nutritional problems arising out of handling the dyes can be easily identified.

Further it was noticed that 34 to 35 percent of the adolescent girls worked for a period of ten hours per day. Only three precent of the girls worked for either less than eight hours or above ten hours per day.

The job involved was 'moderate' in nature for 82 percent of the girls and 'light' for 18 percent of the girls. None of these girls had been involved in heavy work

The income pattern of these workers revealed that 57 percent of the workers could earn around Rs. 701 to 900 per month while 23 percent could earn around Rs. 501 to 700 per month and 11 percent earned between 300 to 500 per month. There were very few (4 percent) who earned above Rs. 900 per month.

2. Health Problems of the Adolescent girls

A. Gastro-intestinal problems

Table V presents the details regarding the existence of Gastro-intestinal problems and their frequency.

TABLE V

GASTRO INTESTINAL PROBLEMS

S. No	Frequency of occurance	Gastro-intestinal problems (in percent)						
		Poor appetite	Nausea	Vomiting	Stomach pain	Diarrhoea	Stomach ulcer	Irritation of mouth
1.	Group A							
	Daily	32.0	Nil	1.5	40.5	3.5	27	65.5
	Frequent	55.5	9.5	10.5	51.5	22.0	60	28.0
	Once in a way	11.5	57.5	47.0	7.0	61.5	Nil	6.5
	No problem	1.0	33.0	42.0	2.0	13.0	13.0	2.0
	Total	100	100	100	100	100	100	100
2.	Group B							
	Daily	Nil	Nil	Nil	Nil	Nil	Nil	Nil
	Frequent	Nil	Nil	NIl	Nil	Nil	Nil	Nil
	Once in a way	Nil	Nil	Nil	8	8	Nil	Nil
	No problem	100	100	100	92	92	100	100
	Total	100	100	100	100	100	100	100

It was shocking to note that 99 percent of the adolescent girls working in the dyeing units had very poor appetite and 98 percent of the girls had stomach pain and irritation of mouth. In addition to these problems they also suffered from gastro-intestinal ulcers, diarrhoea, nausea and vomiting. The problem of irritation of mouth was an every day affair in 65.5 percent of adolescent girls while 60, 51.5 and 55.5 percent suffered frequently from ulcer, stomach pain and poor appetite. Diarrhoea and nausea were also notable health problems though less frequented.

When compared to group A the adolescent girls belonging to the group B who were not working in the dyeing units, were healthy as only (8 percent) reported of stomach pain and diarrhoea that too once in a way only.

This comparison shows that because of working in the dyeing units the adolescent girls do suffer from gastro-intestinal problems.

B.Skin problems

Table VI highlights the skin problems which were present among the female girls working in the dyeing industry.

TABLE VI

SKIN PROBLEMS

S.No.	Frequency of accurance	Skin problems (in percent)					
		Dermatitis	Skin rashes	Itching	Local lesions	Change in the colour	Inflammation
1.	Group A						
	Daily	Nil	8.5	83	15	62	4
	Frequent	5	43.5	13	49	31	55
	Once in a way	65	21	1	20	5	29
	No problem	30	27	3	16	2	12
	Total --	100	100	100	100	100	100
2.	Group B						
	Daily	Nil	Nil	Nil	Nil	Nil	Nil
	Frequent	Nil	Nil	Nil	Nil	Nil	Nil
	Once in a way	Nil	Nil	Nil	Nil	Nil	Nil
	No problem	100	100	100	100	100	100
	Total --	100	100	100	100	100	100

It is evident from Table VI that 98 percent and 97 percent of the adolescent girls suffered from a change in the colour of the skin (natural to pale) and itching of the skin respectively. Eighty eight percent of the adolescent girl workers in the dyeing units complained of inflammation of the skin while 84 percent had developed local lesions,73 percent skin rashes and 70 percent dermatitis. The frequency of occurance of the change in the colour of the skin and itching were more common while inflammation, local lesion and skin rashes were frequent and the occurance of dermatitis was rare with the exception of a few cases.

Table also reveals that the adolescent girls belonging to the group B who were not working in the dyeing units, did not suffer from any kind of skin problems. This proves that the problems faced by the adolescent girls working in the dyeing units are only due to the dyes and chemicals handled by them.

C. Respiratory problems:

Table VII throws light on the respiratory problems that are present among the adolescent girls working in the dyeing units.

TABLE VII

RESPIRATORY PROBLEMS

S. No.	Frequency of occurance	Respiratory problems (in percent)			
		Irritation of nose	Bronchitis	Cough	Laryngeal Oedema
1.	Group A				
	Daily	23	3.5	8.5	1.5
	Frequently	40	9.0	82.0	1
	Once in a way	33	63.5	6.5	55.5
	No problem	4	24.0	3.0	42.0
	Total	100	100	100	100
2.	Group B				
	Daily	Nil	Nil	Nil	Nil
	Frequent	Nil	Nil	Nil	Nil
	Once in a way	Nil	Nil	8	Nil
	No problem	100	100	92	100
	Total	100	100	100	100

Cough was a health problem among 97 percent of the adolescent girls. Irritation of the nose among 95 percent, bronchitis among 76 percent and lahryngeal oedema among 58 percent of the girls were the other respiratory problems found. Among these respiratory problems irritation of the nose was a regular problem for 23 percent of the girls. Cough and irritation of the nose were frequent problems for 82 and 40 percent of the adolescent girls. Out of the 200 adolescent girls 63.5 percent and 55.5 percent suffered from bronchitis and lahryngeal oedema once in a way.

Among the adolescent girls of group B, who did not work in the dyeing units cough was the only respiratory problem reported that too once in a way in 18 percent of the girls only.

D. Menstrual problem

Table VIII gives the menstrual problems faced by the adolescent girls working in the dyeing units.

TABLE VIII

DETAILS REGARDING MENSTRUAL CYCLE

S No.	Details regarding the menstrual cycle	Group A		Group B	
		N	Percent	N	Percent
1.	Regular cycle	56	28	33	82.5
2.	Irregular cycle	144	72	7	17.5
	Total	200	100	40	100
3.	Types of irregularities				
	Long gap	87	44	7	17.5
	Heavy bleeding	83	42	Nil	Nil
	Giddiness	61	30	Nil	Nil
	Pain and weakness	115	57	Nil	Nil
4.	Opinion about chemicals affecting menstrual cycle				
	Yes	164	82	Nil	Nil
	No	36	18	Nil	Nil
	Total	200	200		

It is noteworthy that only 28 percent of the adolescent girls had regular menstrual cycle while the rest 72 percent had some problem or the other in their menstrual cycle. Among those who had menstrual problems 44 percent expressed that they had long gaps in between two menstrual cycles. However, 42 percent had heavy bleeding, 30 percent had giddiness during the menstrual cycles and 57 percent had pain and felt very weak during the menstrual cycles. While 82 percent of the adolescent workers felt that these problems were due to the nature of their work, 18 percent felt that it had nothing to do with their working environment.

Among the adolescent girls who did not work in the dyeing units only 17.5 percent had irregular menstrual cycle, as these girls had recently attained puberty and their cycles had not become regular yet.

E. Other problems:

Table IX presents the health problems other than those mentioned in the previous pages.

TABLE IX

OTHER HEALTH PROBLEMS

S. No	Other health problems	Group A (in percent)					(Group B (in percent)				
		Daily	Frequently	Once in a way	No problem	Total	Daily	Frequently	Once in a way	No problem	Total
1.	Chest Pain	34	34	11	1	100	Nil	Nil	Nil	100	100
2.	Joint pains	33	31	19,5	17.5	100	Nil	Nil	Nil	100	100
3.	General weakness	9.5	31	42	17.5	100	Nil	Nil	5	95	100
4.	Muscle cramps	17	34.5	28.5	20	100	Nil	Nil	Nil	100	100
5.	Feet cracks	28	49	18	5	100	Nil	Nil	2	98	100
6.	Giddiness	1	18	56	26	100	Nil	Nil	Nil	100	100
7.	Irritation of the eyes	58.5	35	5.5	1	100	Nil	Nil	Nil	100	100
8.	Headache	63	35	1	1	100	Nil	Nil	5	95	100
9.	Visual disturbances	4.5	7	44.5	45	100	Nil	Nil	Nil	100	100
10.	Change in colour of the hair	61	35	3	1	100	Nil	Nil	Nil	100	100
11.	Browning of teeth	1	64	3	32	100	Nil	Nil	8	92	100
12.	Falling of hair	5.5	56.5	1	37	100	Nil	2	Nil	98	100

Apart from the gastro-intestinal, skin and respiratory problems, problems like chest pain, joint pain, general weakness and insomnia, muscle cramps, feet cracks, giddiness, irritation of eyes, headache, visual disturbances, change in the hair colour, falling of the hair and browning of the teeth were also noticed among the adolescent girls working in the dyeing units.

Among these problems, the most predominant ones were joint pains, irritation of the eyes, headache, and change in the colour of the hair. While the joint pains may be due to the general posture maintained during the long hours of work, chest pain and irritation of the eyes may be due to contact with smoke, to which these workers are exposed. Feet cracks due to the constant contact of feet with the water which has the dye chemicals and the change in the hair colour and teeth due to constant exposure to the dyes was a common factor. These are the outward signs and symptoms which may have a bearing on the general health of the adolescent girls working in the dyeing units. Those adolescent girls who did not work in the dyeing units suffered from very few health problems like browning of teeth, headache, general weakness, feet cracks and falling of hair that too once in a way.

F. Impact of Health Problems on the Working Pattern of Adolescent Girls:

Table X shows the impact of the health problems on the working pattern of adolescents.

TABLE X

HEALTH PROBLEMS AND THEIR EFFECT ON WORK PATTERN

S. No	Health problems	Changes in routine work (in percent)		
		Take leave	Work for few hours	Reduced work output
1.	Gastro-intestinal problems	43	76	38
2.	Skin problems	8	76	54
3.	Problems in menstrual cycle	54	34	25
4.	Respiratory problems	3.5	54	43
5.	Other health problems	56	84	83

Health problems like gastro-intestinal problems, skin problems, problems in menstrual cycle, respiratory problems, and other problems made the workers either absent themselves from the work or work only for a few hours resulting in reduced work output. Thus from 3.5 percent to 56 percent of the adolescent girls took leave when they had such health problems and 34 percent to 84 percent worked for fewer number of hours and 25 percent to 83 percent turned out less work than usual, when they were severely affected by these health problems.

3. Health Measures available in the Dyeing Units to combat health problems:

A. Health coverage available in the dyeing units.

Among the 40 dyeing units selected 25 units provided medical facilities to the workers while 15 units did not provide any type of health coverage. Within the 25 units itself the type of medical facilities varied from one unit to another. So many adolescent girls were at a disadvantage of not receiving medical facilities.

Table XI gives the kind of health coverage provided by the employers of the dyeing units whereever such coverage was available.

TABLE XI

HEALTH COVERAGE

S.No.	Health coverage	YES		NO	
		N	Percent	N	Percent
1.	Medical facilities available at the units	Nil	Nil	200	100
	- Regular check up	Nil	Nil	200	100
	- Free medicines with out checkup	93	46	107	54
	- Taken to a doctor	37	19	163	81
2.	Leave facilities received				
	- Leave with pay	Nil	Nil	200	100
	- Leave without pay	95	48	105	52
	- Reduced work load	104	52	96	48

It was heartening to note that free medical facilities were available at the units atleast for 46 percent of the adolescent girls while for the rest 54 percent no such free medical supply was available. Nineteen percent of severe cases were referred to a doctor while the majority of 81 percent of the cases were not taken to the doctor as their condition was not considered severe. There was no provision for regular health checkup. With reference to the leave facilities received by the adolescent girls no one was given leave with pay, while 48 percent were given leave without pay and 52 percent were given reduced work load during severe health problems.

B. Protective aids provided and used by the adolescent girls in the dyeing units:

Protective aids like gloves, aprons and face masks were provided to the dyeing workers only in 10 of the 40 dyeing units chosen.

It was very shocking to note that only 24 percent of the adolescent girls working in the dyeing units were given aprons to protect themselves from the harmful chemicals, six percent of the girls were

provided gloves and none of them were provided with face masks. Of these beneficiaries only 37 percent of them used these protective aids regularly while 67 percent did not use them regularly. The reasons for irregularity in using the protective aids as expressed by 57 percent of the adolescent girls were that nobody used them and 19 percent of the girls said that their owners did not provide such protective aids regularly.

C. Hygienic practices followed by the adolescent girls working in the dyeing units:

All the adolescent girls working in the dyeing units washed their hands and legs before having their lunch in the work place. Detergents provided to the girls varied from one dyeing unit to another. Sixty four percent of the girls used soda salt to remove the dyes and other chemicals from their hands and 60 percent of the girls used detergents. Fifty nine, fifty one and thirty eight percent of the girls used bleaching water, bleaching liquor and kerosene respectively. In spite of using these substances, none of the girls were careful enough to wash their hands thoroughly off the dyes and chemicals and so ingested at least a little of them along with their food.

4. Nutritional Status of the Adolescent Girls:

A. Mean Heights and Weights of the Adolescent Girls:

Table XII shows the mean heights and weights of the adolescent girls belonging to both group A and Group B in comparison with the desirable heights and weights suggested by National Centre for Health Statistics (NCHS 1989) and ICMR (1989). The individual data pertaining to heights and weights are presented in Appendix V.

TABLE XII

MEAN HEIGHTS AND WEIGHTS

S.No	Age Group	Mean values				(a)vs(b)
		ICMR	NCHS	GROUP A (a)	GROUP B (b)	't' values
1	Height(cm)					
	13-15yrs	154.8	158.3	139.3±5.2	141.7±4.7	2.2 *
	16-18 yrs	156	163	148.2±4.3	149.2±5.8	0.6Ns
2	Weight (kg)					
	13-15 yrs	46.66	47.8	38.1±2.1	39.6±2.6	2.6**
	16-18yrs	49.92	53.8	40.2±2.8	41.8±2.1	2.7**

Ns-Not significant * Significant at 1% level

** Significant at 5% level

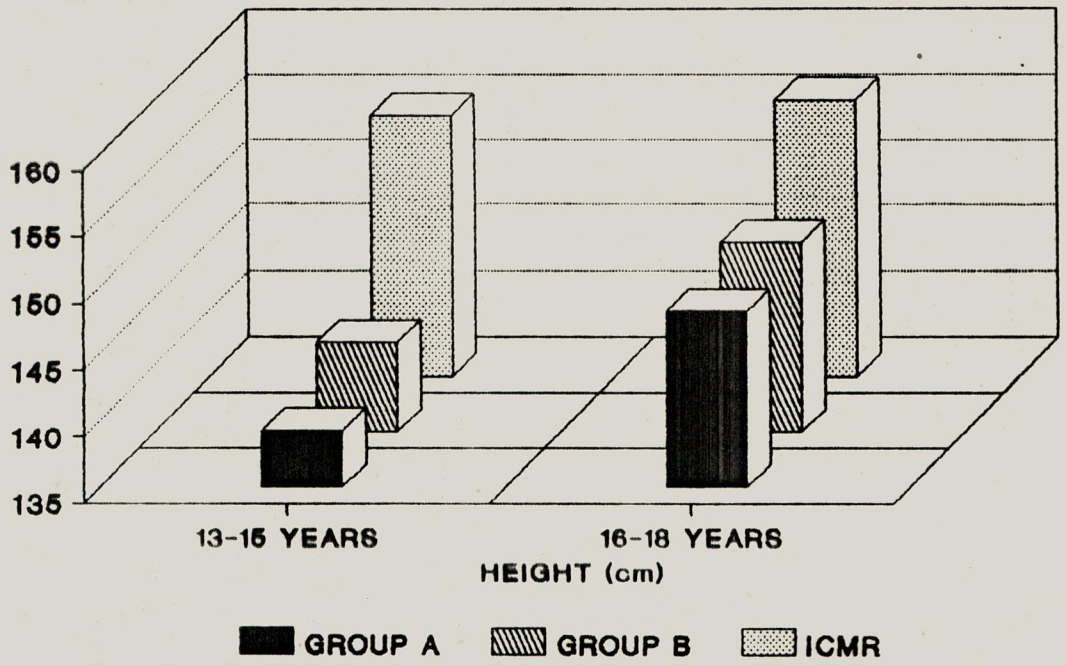
The mean height of the adolescent girls working in the dyeing units was 139.3cm against 141.7cm recorded by the non-working girls of 13 - 15 years age group and 148.2 cm against 149.2 of 16 - 18 years age group.

It is obvious from these values that the heights recorded by the adolescent girls in the present study are lower than the desirable heights. Among the two groups of girls the non working group of girls had better values than those who were working in the industries.

Statistical analysis of the values indicated that the difference in heights between group A and B were significant for 13-15 age group while it was not significant for 16-18 age group.

The mean weights of group A girls of 13-15 and 16-18 years age group were 38.1 and 40.2kg against 39.6 and 41.8kg recorded by group B girls. Statistical analysis of the mean weights indicated that the difference between the group A and group B adolescent girls were significant at 1% level for both 13-15 and 16-18 years age group. The mean heights and weights for group A and B girls are shown in Figure 2.

MEAN HEIGHTS OF THE ADOLESCENT GIRLS



MEAN WEIGHTS OF THE ADOLESCENT GIRLS

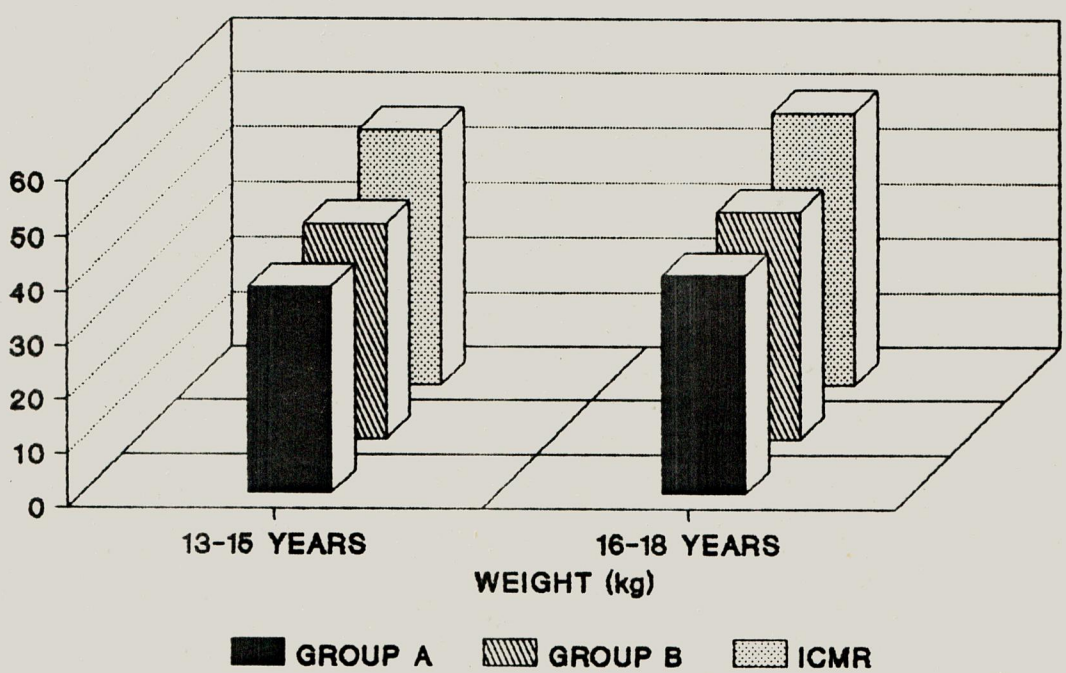


FIGURE 2

B. Findings based on the Clinical Examination of the Adolescent girls:

Table XIII gives the details regarding the signs and symptoms of nutritional deficiencies for group A and B adolescent girls.

TABLE XIII

FINDINGS BASED ON CLINICAL EXAMINATION

S.No	Parameters for clinical examination	Group A		Group B	
		N	Percent	N	Percent
1	Normal	57	29	29	72.5
2	Malnourished:				
	Poor musculature	88	44	3	8
	Deficient subcutaneous fat	54	27	2	5
	Gross muscular wasting	6	3	NIL	NIL
	Sparse hair	88	44	NIL	NIL
	Easy pluckability of hair	34	67	2	5
3	Vitamin A deficiency				
	Bitot's spot	7	4	NIL	NIL
	Dry or rough skin	122	61	4	10
	crazy pavement ofskin	26	13	2	5
4	Others				
a)	Angular Stomatitis	70	35	5	12.5
b)	Bleeding gums	8	5	NIL	NIL
c)	Red/raw/glazed tongue	26	13	NIL	NIL
d)	Dental caries	86	43	6	15

Many girls working in the dyeing units showed signs and symptoms of malnourishment. Sixty seven per

cent of the girls had easily pluckable hair, 44 per cent had sparse hair and poor musculature and 27 per cent of the girls had deficient subcutaneous fat. Only three per cent of them showed signs of gross muscular wasting.

Among the vitamin A deficiency signs dry, rough skin and crazy pavement of the skin were seen in 61 and 13 per cent of the girls respectively.

Dental Caries and angular stomatitis were seen in 43 and 35 per cent of the girls respectively. Bleeding gums and coloured tongue were also seen in a few cases.

Nutritional deficiency signs were very scanty among the group B girls. Dental caries, angular stomatitis and dry, rough skin were the only prominent deficiency symptoms. Few girls in group B had poor musculature, deficient sub-cutaneous fat, easy pluckability of the hair and crazy pavement of skin.

C. Findings based on the Blood and Urine Examination

Table XIV gives the details regarding the haemoglobin content of the blood samples of both group A and Group B adolescent girls. Individual haemoglobin values are given in Appendix VI.

TABLE XIV

MEAN HAEMOGLOBIN VALUES OF THE GIRLS

S No	Haemoglobin (gm/dl)	Group A (a)			Grpup B (b)			(a) v(b) 't' values
		N	Per cent	Mean (g)	N	per cent	Mean (g)	
1.	Normal (14 +/-23 #)	Nil	Nil	Nil	Nil	Nil	Nil	Nil
2.	Mildly anaemic (10 - 13)	6	17	10.7 +/- 0.37	27	77	11.2 +/- 0.86	2.3*
3.	Moderately anaemic (7 - 10)	29	83	8.8 +/- 1,01	8	23	9.3 +/- 0.34	2.7**
4.	Severely anaemic (Below 7)	Nil	Nil	Nil	Nil	nil	Nil	Nil
	Total	35	100		35	100		

\# Standard value given by WHO 1990

* Significant at 5% level

** Significant at 1% level

The mean haemoglobin values for the moderately anaemic group A and group A girls werre found to be 8.8 and 9.3g/dl and for mild anaemic 10.7 and 11.2g/dl respectively. This difference in the haemoglobin values between the two group of girls was statistically significant at 5% and 1% level respectively. The poor intake

of iron by these girls can also be one of the causes for lower haemoglobin values. Fig. 3 shows the mean haemoglobin values of the girls.

Table XV gives the details regarding the red blood corpuscle count of the blood samples of group A and group B girls. Individual values are given in Appendix VI.

MEAN HAEMOGLOBIN VALUES OF THE ADOLESCENT GIRLS

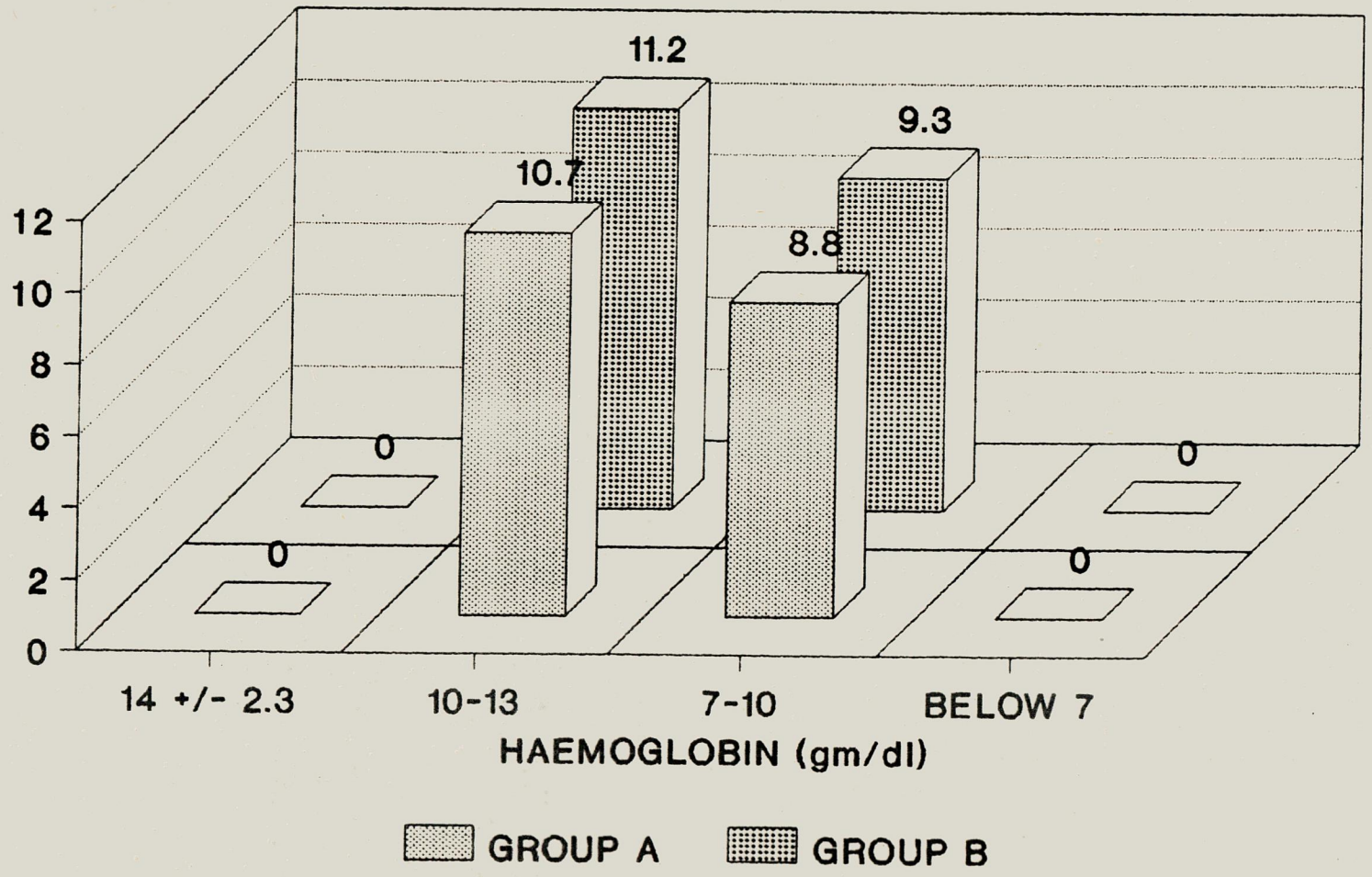


FIGURE - 3

TABLE XV

RED BLOOD CORPUSLE COUNT OF THE GIRLS

S.No	Red Blood Corpuscles count (millions/cumm)	Group A		Group B	
		N	Percent	N	Percent
1	Normal 48+/-0.6*	NIL	NIL	NIL	NIL
2	2,5 and below	4	11	NIL	NIL
3	2.6 - 3.0	11	33	5	14
4	3.1 - 3.5	10	28	5	14
5	3.6 - 4.0	8	23	17	50
6	4.1 and above	2	5	8	22
	Total	35	100	35	100

* Normal value given by WHO 1990

According table XV a maximum of 33 per cent of the adolescent girls belonging to group A had a red blood cell count of 26-3 millions/cu.mm. A minimum of 5% girls alone had a count above 4 millions/cumm. On the other hand in the control group a maximum of 50 per cent of the girls had a count of 3·6-4 millions/cumm.

Table XVI gives the details regarding the differential count of the blood sample drawn from both group A and B girls. Individual values are given in Appenxix VI.

TABLE XVI

DIFFERENTIAL COUNT OF THE ADOLESCENT GIRLS

S.NO	Parameter for Blood Analysis	Group A		Group B	
		N	Percent	N	Percent
1	Differential Count				
a.	Polymorphs (%) (60-65%)*				
	Less than 60 %	28	80	NIL	NIL
	60 - 65%	5	14	30	86
	65 and more	2	5	5	14
	Total	35	100	35	100
b.	Lympocytes (%) 25-30%)*				
	Below 25	NIL	NIL	NIL	NIL
	25 - 30	5	14	35	100
	Above 30	30	86	NIL	NIL
	Total	35	100	35	100
c.	Eosinophil (%) (1-4%)*				
	Less than 4	NIL	NIL	24	67
	5 - 9	7	20	11	33
	Above 9	28	80	NIL	NIL

* Normal value given by Chatterjee (1987).

According to table XVI the findings of differential count shows that the percentage of polymorphs were less among the group A girls and the lympocytes and eosinophil appear to be altered in

them. A maximum of 34 per cent of the girls had a decreased polymorph value of 35-40% and a maximum of 62 per cent had a increased lympocyte value of 35-40%. An increased eosinophil value of 9.11% were found in 54 per cent of the girls.

These results are in line with the studies of Chatterjee (1987) according to whom skin diseases cause an increase in eosinophil while administration of chemicals like Benzene and sulphonamide produce leucopenia.

On the other hand in the group B girls the variation in the percentage composition of polymorphe,lymphocyte and eosinophil were very mild and not of much significance.

Table XVII gives the details regarding the biochemical picture of group A and B girls based on their urine sample analysis. Individual values are given in Appendix VII.

TABLE XVII

FINDINGS BASED ON URINE ANALYSIS

S.No	Parameters for Urine analysis	N	Group A Percent	Group B N	Group B Percent
1	Albumin (Nil)*				
	Faint trace	25	72	NIL	NIL
	NIL	10	28	35	100
	Total	35	100	35	100
2	Sugar (Nil)*	NIL	NIL	NIL	NIL
3	Acetone (NIL)*	NIL	NIL	NIL	NIL
4	Pus cells (1-2/hpf)*				
	Below 1 - 2	14	40	31	89
	1 - 2	12	34	4	11
	above 1 - 2	9	26	NIL	NIL
	Total	35	100	35	100
5	Red Blood Corpusles				
	NIL *	8	23	35	100
	0/2 hpf	23	66	NIL	NIL
	2 - 4 /hpf	4	11	NIL	NIL
	Total	35	100	35	100
6	Epithelial cells (2-3 or 4-6/hpf)*				
	2 - 3	15	43	32	91
	4 - 6	12	34	3	9
	Above 4 - 6	8	23	NIL	NIL

* Normal values given by Vareley (1988).

As is evident from Table XVII 72 per cent of the adolescent girls belonging to group A had faint traces of albumin in their urine while none of the group B girls had albumin in their urine. Since albumin is not found in normal people, the change found is group A girls needs further investigation.

It was heartening to note that none of the girls of group A and B had either sugar or acetone in their urine.

A minimum of 26 per cent of group A girls alone showed an increased number of pus cells than the normals. Nearly 66 per cent of the girls showed presence of Red Blood Cells of 0-2/hpf in the urine. An increased number of epithelial cells of more than 4-6/hpf were found in 23 per cent of the girls only.

The adolescent girls belonging to the group B showed only normal ranges of pus cells, red blood cells and epithelial cells.

D. Mean food and nutrient intake of the adolescent girls

Table XVIII gives the mean food intake of the adolescent girls belonging to both group A and B. Individual food intake of the girls are given in Appendix VIII.

TABLE XVIII

DETAILS REGARDING MEAN DAILY FOOD INTAKE

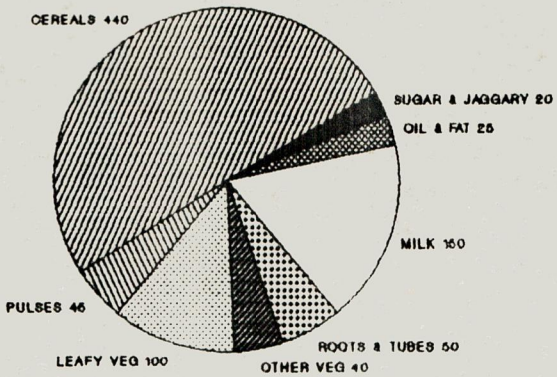
S.No	Food Items	Standard ICMR 1984 (g)	Group A Mean value (g)	Group A PERcent surplus deficit	Group B Mean value (g)	Group B Percent surplus(+) deficit(-)
1	Cereals	440	298	-32	357	-19
2	Pulses	45	9	-80	11	-76
3	Leafy vegetables	100	18	-82	26	-74
4	Other vegetables	40	9	-77.5	11	-72.5
5	Roots & Tubers	50	10	-80	20	-60
6	Milk	150	80	-47	85	-43
7	Oil ahd fat	25	2.0	-92	2.5	-90
8	Sugar & Jaggery	20	10	-50	10	-50

It is evident that all the food items consumed by both group A and B girls did not meet the food amounts recommended by ICMR (1984) Consumption of cereals, milk and sugar and jaggery were less by 32,47 and 50 per cent in group A and by 19,43 and 50 per cent in Group B. The other food items namely other vegetables, oil and fat had a deficit of 77.5 to 92 per cent by group A while the food intake deficits were also there among the group B girls, the extent of deficit was much less compared to group A girls

indicating that these girls could not consume as much as those in group B. Poor appetite and other gastro intestinal problems faced by group A girls due to the type of work they do can be one of the main reasons for their poor intake. Figure 4 shows the mean food intake of the adolescent girls.

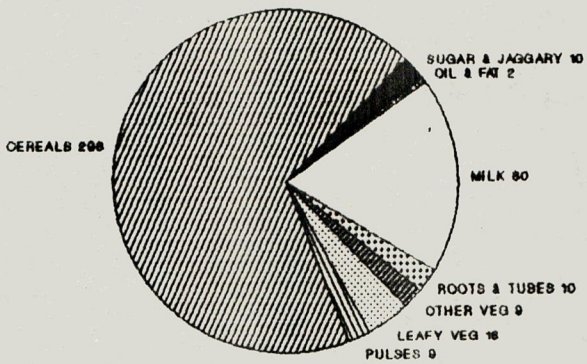
Table XIX gives the details regarding the mean nutrient intake of the adolescent girls. Individual nutrient intakes are given in Appendix IX.

MEAN DAILY FOOD INTAKE OF ADOLESCENT GIRLS



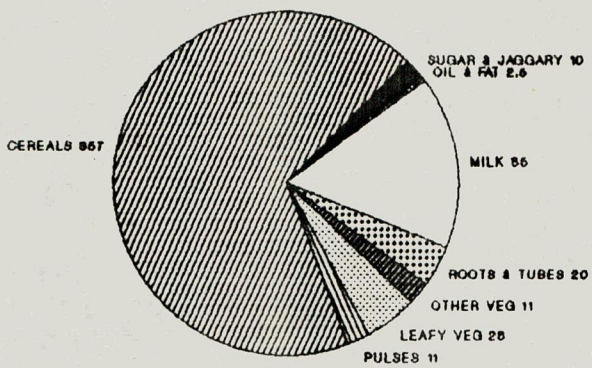
ICMR (1984)

MEAN DAILY FOOD INTAKE OF ADOLESCENT GIRLS



MEAN VALUE (GROUP A)

MEAN DAILY FOOD INTAKE OF ADOLESCENT GIRLS



MEAN VALUE (GROUP B)

FIGURE – 4

TABLE XIX

MEAN DAILY NUTRIENT INTAKES

S. No	Nutrients	Standard ICMR (1989) Values	Group A		Group B	
			Mean Value	Percent Surplus (+) deficit (-)	Mean values	Percent surplus (+)or Deficit (-)
1.	Energy (K.cal)	2060	1203	-42	1441	-30
2.	Proteins (g)	65	26	-60	33	-49
3.	Fat (g)	22	7	-68	8	-64
4.	Calcium (mg)	550	206	-63	259	-53
5.	Iron (mg)	29	4	-86	11	-62
6.	Carotene (ug)	2400	1302	-46	1934	-19
7.	Retinol (mg)	600	326	-46	484	-19
8.	Thiamine (mg0	1.0	0.7	-30	0.8	-20
9.	Riboflavin(mg)	1.2	0.3	-75	0.4	-67
10	Niacin (mg)	14	10	-29	11.3	-19
11	Ascorbic acid (mg)	40	38	-5	47	+17.5

%

The nutrients that had greater deficits were iron, riboflavin,fat,calcium and proteins both among group A and B girls. Only ascorbic acid was found to be in surplus among control group girls. All the other nutrients were also found to be lower than the required values. These deficiencies in the nutrients are responsible for the major clinical symptoms found among the girls like malnourishment and angular stomatitis.

Summary and Conclusion

V. SUMMARY AND CONCLUSION

The present study entitled "Health and Nutritional Status of Adolescent Girls Working in Dyeing Units" was conducted with the aim of studying the nutritional status of adolescent girls working in the dyeing units, their health problems, health coverage available at the place of work and suggesting ways and means of eliminating or reducing the health hazards while at work.

The area selected for the study was Karur Taluk in Trichy District from where 40 dyeing units of small and medium sizes were chosen for carrying out the study. Two hundred adolescent girls working in the dyeing units were drawn along with another group of 40 adolescent girls who were not working in the dyeing units. The girls had similar socio-economic background and dietary habits.

An interview schedule was evolved to collect information from the adolescent girls regarding their family background, work load and duration, health problems, hygenic practices and health facilities provided to them.The nutritional status of these girls was assessed in terms of heights and weights, clinical picture, bio-chemical picture and dietary survey.

The results obtained are presented in the following paragraphs.

Karur had a total of 670 dyeing units of which 350 were small in size, 200 large and 120 medium in size.

1. The study revealed that the educational status of the educational status of the adolescent girls was poor as none of them had studied beyond the middle school level. Eighty five percent of the families of the adolescent girls were nuclear in nature and the average per capita income of the families ranged between Rs.251-300 per month (82 percent).

2. The adolescent dyeing workers under investigation had a working experience of three to eight years, doing moderate work for 8-10 hours every day. Their monthly income was based on the work output and so ranged from Rs.300-900 per month or even above.

3. The gastro-intestinal problems like poor appetite, stomach pain and irritation of the mouth were faced by the adolescent dyeing workers while same were notably absent among those who were not working in the dyeing industry.

4. Skin problems like change in the colour, itching and inflammation were commonly reported by the adolescent dyeing workers, while none of the girls who did not work in the dyeing units reported of any kind of skin problems. Thus these skin problems may be arising due to the dyes and chemicals with which they come into contact.

5. Inhalation of smokes and dyes caused respiratory problems like cough, irritation of the nose and bronchitis which were reported to be present only among the adolescent dyeing workers.

6. According to the study many of the adolescent dyeing workers felt that the chemicals affected their menstural cycle and 72 percent of the girls had irregularities like long gaps, heavy bleeding, giddiness and pain and weakness during menstrual cycle.

7. The health problems of the adolescent dyeing workers other than those mentioned above were chest pain, irritation of the eyes, change in the hair colour, head ache and feet cracks, which were not commonly found among those who were not working in dyeing units.

As a result of these health problems discussed above the adolescent dyeing workers either took leave or worked for a few hours only which resulted in redued worked output.

8. The medical facilities that were provided by the dyeing units varied from one unit to another. Among the 40 dyeing units chosen fifteen dyeing units did not provide any medical facilities. Regular health check-up was not carried out in any of the units. However, a few units provided free medicines and leave facilities during severe health problems.

9. According to this study it was found that only 24 percent of the adolescent girls were benefiting from protective facilities like aprons, and gloves. Even these girls did not use their protective aids regularly as they felt that it was very uneasy to work with.

10. The mean heights and weights as recorded during the study showed that the adolescent dyeing workers had slightly lower mean values of heights and weights when compared to the adolescent girls who did not work in the dyeing units.

The nutrient deficiency signs and symptoms that were very prominant among the dyeing workers were easy pluckability of hair, dry or rough skin, sparse hair, and dental caries, while very few girls of the non-working group showed these signs and symptoms of deficiency.

11. The haemoglobin values of the adolescent dyeing workers showed that 83 percent were moderately anaemic while 23 percent of the non-working girls were only moderately anaemic.

Neither the adolescent dyeing workers nor the non-working adolescent girls met the required allowances for food and nutrient intake. Among the food items oil and fat, leafy vegetables, pulses and roots and tubers had maximum deficits while among the nutrients iron, riboflavin, fat, calcium and protein had maximum deficits. Within the two groups itself the non-working adolescent girls had a slightly better intakes of food and nutrients than the adolescent dyeing workers.

The red blood corpuscles count of the adolescent girls were lower in both the dyeing workers and those who were not working. However the extent of deficit was less in the latter group.

The differential count picture of the adolescent dyeing workers showed that their polymorphs percentage were decreased and the lymphocyte and eosinophil percentage increased than the normal values showing some kind of a disorder. On the other hand, the differential count picture of the non-working adolescent girls showed very few changes which are insignificant.

The urine analysis of the adolescent dyeing workers showed slight traces of albumin and red blood corpuscles which were not present among the non-working adolescent girls.

Many washing substances like bleaching water, bleach liquor and detergents used by the dyeing workers to wash their hands off the dyes and chemicals. But it was found that none of the girls took care to wash their hands thoroughly especially before having their lunch resulting in ingestion of the dyes and chemicals along with the food.

These results lead us to the conclusion and recommendations that specific health hazards are inevitable among dyeing workers and adequate protective measures should be undertaken to protect them from such hazards.

- the dyeing workers should be definitely provided with adequate protective aids like gloves, aprons and face masks and using the same made compulsory.
- regular medical check-up should be carried out for the dyeing workers.
- the dyeing workers should be made aware of the importance of hygienic practices.

Special nutritional care may be required to take care of the inadequate diets for which alone the poor have an access.

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Appendix

APPENDIX - I

INTERVIEW SCHEDULE TO ELICIT INFORMATION ON HEALTH AND NUTRITIONAL STATUS OF ADOLESCENT GIRLS WORKING IN DYEING UNITS

I GENERAL INFORMATION:

1. Name of the investigator :
2. Name of the adolescent worker :
3. Age :
4. Educational Status :
5. Occupation :
6. Income/Month :
7. Type of Family : Joint/Nuclear
8. No of Members in the family :

No.	Name	Marital status	Age (yrs.)	Education	Occupation	Monthly income (Rs.)

9. Type of work done :

: Light

:Moderate

: Heavy

10. Years of experience in the unit

11. No. of working hours/day :

12. Attendance at work for the past 3 months :
Regular/Irregular

b) If irregular, list out the reasons :

1.

2.

3.

13. Amount of work turned out day

Initially at the time of joining :

II HEALTH PROBLEMS:

Type	Type of Occurance		
	Once in a way	Frequent	Daily
a) Gastro-intestinal :			
Poor appetite			
Nausea			
Vomiting			
Stomach pain			
Diarrhoea			
Ulcers			
Irritation of the mouth			
b) Skin Problems:			
Dermatitis			
Skin rashes			
Itching			

Type	Frequency of Occurance		
	Once in a way	Frequent	Daily
Local lesions			
Change in the colour			
Inflammation			
c) Respiratory:			
Irritation of nose			
Bronchitis			
Cough			
Cold			
Lahryngeal oedema			
d) Others:			
Chest pain			
Shoulder & neck pain			
Joint pains			
General weakness			
Muscle cramps			
Feet cracks			
Giddiness			
Fever			
Insomnia			
Irritation of the eyes			
Headache			
Visual disturbances			
Change in the hair colour			

15. Do you have any other health problems?

If yes, list the problems:

a)

b)

c)

16. Which of these heath probems affect your daily routine in the unit? How?

No.	Type of Problem	Change in the routine work		
		Take Leave	Work for few hours	Work full day but reduced work output	Any other

17. Is your menstrual cycle regular: Yes/No

b) If no, list the problems:

1.

2.

3.

18. Do you think the chemicals you use affect your menstrual cycle? Yes No

19. Do these health problems affect your daily dietary intake?

Yes No

Yes No

b) If yes, in what ways.

No.	Type of Problem	Changes in the diet			
		Reduced Quantity	Change in consistancy	Bland diet	Others

20. How much do you spend monthly on medicine?

21. Do you report your health problems to the management?

Yes No

22. Are you given any health coverage?

Yes No

b) If yes, what kind of health coverage?

No.	Particulars	Yes	No
1.	Help received from the employer when sick.		
2.	Medical facilities at unit None Free Medicines without check-up (Name the Medicines)		

No.	Particulars	Yes	No
	Regular check-up		
3.	Other facilities received		
	Leave with pay		
	Leave without pay		
	Reduced work load		

23. Name the chemicals you are working with every day:

    1.

    2.

    3.

24. Are you provided with any protective aids like gloves,aprons,face masks, etc. when you work?

    Yes No

    a) If yes, do you use it regularly?

    Yes No

    b) If you are not using regularly give reasons.

    1.

    2.

    3.

ii) a) If you are not provided with any protective aids do you feel that these are necessary?

    Yes No

    b) Give reasons.

    1.

    2.

    3.

25. Are you bringing and using any protective items in your personal interest?

Yes No

26. Do you think the chemicals you use might lead to health hazards?

Yes No

27. Do you wash your hands before having your food in the unit?

Yes NO

28. Do you use any detergents for washing your hands?

Yes No

29. If you use anything other than detergents, specify.

1.

2.

3.

30. Do you ensure that all the chemicals are removed in the process of washing?

Yes No

III DIETARY SURVEY:

31. a) Are you provided any subsidised food in the unit?

Yes No

b) If yes, what type?

Food : Yes/No

Snacks : Yes/No

Tea : Yes/No

APPENDIX - II

CLINICAL EXAMINATION PROFORMA

HEIGHT: WEIGHT:

1. Malnourished

   Poor musculature

   Deficient subcutaneous fat:

   Gross muscular wasting:

   Nutritional oedema:

   Anaemia:

   Moonface

   Sparse hair

   Easy pluckability of hair

2. Vitamin-A deficiency

   Xerosis

   Bitot's spots

   Dry or rough skin

   Crazy pavement of skin

   Hyper keratosis

3a) Angular stomatitis

b) Bleeding gums

c) Red/Raw/Glazed tongue

d) Tenderness of calf

e) Dental caries

APPENDIX III

Procedure For Blood Tests:

1. Determination of Haemoglobin by Cyanmethaemoglobin Method:

Principle

The haemoglobin is treated with a reagent containing potassium ferricyanide, potassium dihydrogen phosphate. The ferricyanide forms mathaemoglobin which is converted to cyanmethaemoglobin by the cyanide.

Reagents Used

1. Ferricyanide - Cyanide reagent
2. Cyanmathaemoglobin standard

Procedure:

Add 0.02 ml of blood to 4 or 5 ml of the reagent. Stand at least 4 minutes and read against a water tank at 540 mμ. Read the standard in the same way. Then

$$\text{Grams haemoglobin per 100 ml blood} = \frac{\text{Reading of unknown}}{\text{Reading of standard}} \times \text{Dilution factor} \times \frac{\text{Concentration of Standard in mg per 100 ml}}{1000}$$

The dilution factor is 201 or 251 according to whether 4 or 5 ml of reagent is used.

2. Total Count of Red Blood Corpuscles:

Instrument used for this purpose is 'Improved Neubauer Haemocytometer'. The instrument consists of (i) a special glass slide (counting chamber)(2) one graduated pipette for R.B.C. count and (3) another pipette for W.B.C. count. In addition to this, dilution solutions and cover slip are also required.

Method of Counting R.B.C:

One drop of diluted blood from the red cell - counting pipette is introduced in the counting chamber under the cover-slip. Since the under surface of the coverslip is 1/10th mm high from the surface of the counting chamber, the volume of each square is 1/4,000th cu.mm. Red cells are counted in the five groups of 16 small squares. To avoid counting a corpuscle twice, those on a line are counted only when on the top and left lines or on the bottom and right lines.

The number of red cells per cu.mm

$$= \frac{\text{Number of cells counted X dilution X 4,000}}{\text{Number of small squares counted}}$$

when the dilution is 1:200 the formula reduces to

$$= \frac{\text{Number of cells counted X 200 X 4000}}{80} =$$

10,000 x number of cells counted in 80 small squares

3. Determination of Differential Leukocyte count by Microscopic Examination of Blood:

Apparatus required:

Microscope, glass slides, surgical needle, cover slip, stop watch, spirit, leishman's stain.

Preparation of the Blood Smear:

Prick the ball of the finger and mount a drop of blood at once on a slide ¼ inches from the end. Place another slied at 45° angle just in front of the drop and gently push the latter slide into the drop allowing the blood to spread along the edge of this slide. Then pull the slide smoothly and not too rapidly to the end of this slide. Allow the film to dry in air.

Staining the Smear by Leishman's Stain:

Leishman's stain consists of a mixture of alkaline methlene blue and cosin dissolved in pure methyl alcohol. The dry film is well covered with the stain which is evenly distributed over the slide for one minute. At the end of one minute double the quantity of distilled water is carefully added and made to stay on the slide. The diluted stain is allowed to stand for seven minutes. The mixture is then poured off and the slide gently blotted and dried. The film is then examined under microscope.

(i) POLYMORPH: These cells are usually spherical granules stqaining reddish purple. Nucleus contains a number of fine neutrophil granules staining reddish purple. The nucleus is many lobed (2 - 7).

(ii) EOSINOPHIL: The nucleus is commonly two or three lobed. The granules are coarse and stain with acid dyer.

(iii) LYMPHOCYTE: These cells are slightly larger than R.B.C. Nucleus is large almost filling the cell of narrow rim of cytoplasm. The large lymphocytes are not usually seen in the circulating blood.

APPENDIX IV

Procedure for Urine Tests

1. Test for Albumin:

Mix equal volumes of urine and saturated ammonium sulphate solution. Albumin gets precipitated by completely saturating the urine with ammonium sulphate.

2. Benedict's test for Glucose:

Add eight to ten drops of urine to 5 ml of the Benedict's reagent in a test tube and boil for two minutes, or place in a boiling water both for three minutes. Allow to cool spontaneously. A precipitate forms varying from greenish to yellowish brown to reddish brown, roughly according to the amount of reducing substance present.

3. Rothera's Nitroprusside Test for Acetone:

Saturate about 5 m of urine with solid ammonium sulphate and add alittle sodium nitroprusside, either about 0.5ml of a 2 percent solution or a small quantity of the powdered solid. Mix and add about 0.5ml of concentrated ammonia. A purple colour is given by acetoacetic acid and acetone which is maximal in about 15 minutes. If the ammonia is layered on, a purpe ring is obtained at the junction of the liquids.

4.Microscopic Examination of Urinary Deposits:

Early morning urine is centrifuged and the deposits are examined under microscope.

i) Red-blood-cells:

These appear round or biconcave in shape, and yellow coloured, and have no nucleus.

ii)Pus cells:

These cells are mainly polymorphonuclears.

iii)Epithelial cells:

These cells can be grouped into three, squamous epithelium, transitional epithelium and small round or polygonal cells. The first group are large cells, flattish in appearance,with smal oral shaped nuclei. The second group of cells have a tail like portion.

APPENDIX - V

HEIGHTS AND WEIGHTS OF ADOLESCENT GIRLS

(GROUP A)

13 - 15 years

S.No.	Height (cm)	Weight (Kg)	S.No.	Height (cm)	Weight (Kg)
1.	135	40	33	141.5	39
2.	136.5	36	34	136	38.5
3.	141	40	35	132	39.5
4.	137	40.5	36	137.5	38
5.	139.5	39	37	133	37.4
6.	138	36.5	38	134	36
7,	135.5	37	39	139.5	38
8.	140	38.5	40	138	37
9.	141.5	39	41	136.5	38
10.	136	39.5	42	135	38.5
11.	137	38.5	43	137	36.5
12.	138	38	44	139	40.5
13.	136	37.5	45	141	35
14.	141	36	46	136	40
15.	139	35	47	135	36
16,	140	38	48	134.5	39
17.	141.5	37.5	49	136.5	40.5
18.	137	36.5	50	137	38.5
19.	138.5	38	51	133	39
20.	133	37	52	134.5	36.5
21.	134.5	35	53	132,2	40
22.	139	39	54	132	38
23.	137	40.5	55	132	39.5
24.	141.5	35	56	134	38
25.	138	37	57	141	38.5
26.	139.5	35,5	58	137	39
27.	133,5	39	59	136	40
28.	136.5	38.5	60	132	40.5
29.	139	37	61	141	39.5
30.	140.5	38.5	62	142.5	40.5
31.	141.5	35	63	140	40
32.	137.5	36.5	64	142	39

16 - 18 years

S.No.	Height (cm)	Weight (Kg)	S.No.	Height (cm)	Weight (Kg)
1.	147.5	37	35	147	43
2.	151	36.5	36	143.5	44.5
3.	153	41	37	145	42
4.	144.5	43	38	147	41.5
5.	143.25	39	39	152	39
6.	147	41.5	40	154.5	38.7
7.	149	39.5	41	149	37
8.	153.5	36	42	147.5	39
9.	144	37	43	146	41
10.	151	39.5	44	145	39.5
11.	150.5	42	45	142.75	39.8
12.	152.25	40.5	46	149.25	41.5
13.	155	43	47	146	42
14.	146	38.7	48	147	43
15.	145	39.8	49	149	43
16.	145.5	40.1	50	153	41
17.	149	38	51	152	42
18.	147	41	52	148.5	43,5
19.	150.5	43	53	150.75	41
20.	153	41.5	54	147	39.5
21.	151.25	41	55	153	38.5
22.	148	42	56	146	39
23.	149.5	44	57	151	42
24.	148.5	43	58	152	43.5
25.	148	42.5	59	147	41
26.	144	39.5	60	153	42
27/	143.5	39	61	154.5	39.5
28.	145	43	62	144	39
29.	149	37.8	63	150	38.5
30.	146	38.7	64	148	40.5
31.	151	43.5	65	154.5	39.5
32.	150.25	39	66	152.5	38.5
33.	143	42.5	67	143	39
34.	146.5	41	68	143	40.5

Contd....

S.No.	Height (cm)	Weight (Kg)	S.No.	Height (cm)	Weight (Kg)
69.	141	41	103	149	39
70.	154.5	40	104	148.5	37.5
71.	141.5	38	105	153	39
72.	144	39	106	155	41
73.	151	43.5	107	150.5	41.5
74.	147	44	108	149	40
75.	148	39.5	109	153	39
76,	142.5	38.5	110	148.5	41
77.	151.5	40.5	111	148	41.5
78.	144,5	41	112	154	38
79.	148	31	113	152.5	43
80.	143.5	40.5	114	153	40.5
81.	150	42	115	144	39
82.	151.5	38.5	116	154.5	38
83.	149	41	117	143.5	43
84.	153	39.5	118	144.5	41.5
85.	147.5	40	119	145	37.5
86.	148	41,5	120	151	39
87.	154	42.5	121	153.5	41
88.	147.5	39	122	154	42
89.	149	39.5	123	150	44.5
90.	154,5	40.5	124	147	45
91.	155	38	125	148.5	45.5
92.	149.5	39.5	126	149	43
93.	146	40	127	151	38
94.	144.5	41,5	128	149.5	41
95.	145	42	129	150	40.5
96.	145.5	43	130	152	42.5
97.	147	44.5	131	147.5	40
98.	148,5	42	132	153.5	39.5
99.	151	41	133	149	39
100.	149	42.5	134	151	41
101	153	43.5	135	153	38.5
102	154,5	43	136	154.5	43

APPENDIX VI

BLOOD ANALYSIS DETAILS (GROUP A)

S.No	Haemoglobin g/dl	TOTAL R B C count Millions/ cu.mm	Differential Count		
			Polymorphs (%)	Lymphocyte (%)	Eosinophil (%)
1	8.6	2.88	35	56	9
2	8.2	2.90	52	36	12
3	8.2	2.78	48	36	7
4	8.1	2.54	40	38	7
5	8.3	2.34	65	53	14
6	8.5	2.52	50	45	11
7	8.5	2.50	39	37	8
8	8.3	2.43	47	37	11
9	8.6	2.67	45	38	10
10	8.4	2.34	39	47	9
11	7.9	3.10	39	37	7
12	8.4	2.76	43	54	10
13	8.7	2.31	35	56	9
14	8.3	2.88	54	38	11
15	8.6	2.51	53	37	10
16	8.9	2.76	49	38	9
17	8.7	3.24	52	38	12
18	8.4	2.52	45	37	10
19	8.0	2.53	39	45	9
20	8.9	2.81	43	39	11
21	8.8	2.47	54	37	10
22	8.3	3.21	32	47	8
23	8.4	2.85	49	37	9
24	8.7	2.30	39	37	10
25	7.8	2.61	48	53	11
26	8.9	2.71	39	35	7
27	9.0	2.32	48	53	11
28	7.6	3.41	37	52	10
29	8.8	2.80	41	54	9
30	8.0	4.53	53	45	10
31	10.7	3.78	51	35	10
32	10.5	3.62	47	37	9
33	11.3	3.82	50	36	8
34	10.8	4.32	35	42	9
35	10.2	3.46	39	41	11

BLOOD ANALYSIS DETAILS (GROUP B)

S.No	Haemoglobin g/dl	Total R.B.C. count Million/cu mm	Differential Count		
			Polymorphs (%)	Lymphocytes (%)	Eosinophils (%)
1	9.0	2.96	35	36	6
2	9.4	2.87	43	37	7
3	9.6	2.78	45	36	8
4	9.5	2.83	39	35	7
5	9.3	2.76	50	39	6
6	8.7	2.53	52	38	8
7	9.6	2.98	56	37	6
8	8.9	2.78	40	36	6
9	10.3	3.56	35	40	7
10	12.1	3.88	39	41	9
11	10.4	2.96	42	36	6
12	11.5	3.53	37	36	7
13	12.3	3.76	38	35	8
14	10.7	2.93	40	36	9
15	10.2	3.46	41	35	7
16	12.3	3.78	37	39	6
17	12.4	4.26	38	40	6
18	11.9	3.98	39	36	7
19	10.5	2.96	40	36	8
20	11.5	2.78	41	36	8
21	10.1	3.78	43	37	9
22	10.4	3.94	39	38	6
23	10.8	2.76	37	38	6
24	11.6	3.96	39	36	7
25	10.4	3.48	40	39	7
26	10.0	3.12	45	40	8
27	10.2	3.42	37	41	6
28	10.4	3.53	50	36	7
29	11.5	3.42	52	40	8
30	11.6	3.52	54	37	6
31	11.7	3.82	36	38	7
32	12.1	3.96	39	43	6
33	12.4	3.79	42	41	5
34	12.5	3.98	36	39	5
35	11.9	3.82	37	36	7

APPENDIX VII

URINE ANALYSIS DETAILS (GROUP A)

S.NO	Albumin	SUgar	Acetone	Pus cells hpf	R B C hpf	Epithelial cells/hpf
1	Faint trace	NIL	NEGATIVE	2-4	1-2	6-8
2	NIL	NIL	NEGATIVE	0-1	Occassional	1-3
3	NIL	NIL	NEGATIVE	1-2	NIL	2-4
4	NIL	NIL	NEGATOVE	0-1	N NIL	1-2
5	Faint trace	NIL	NEGATIVE	2-3	Occassional	6-8
6	Faint trace	NIL	NEGATIVE	1-3	1-2	5-7
7	Faint trace	NIL	NEGATIVE	1-2	Occassional	2-4
8	Faint trace	NIL	NEGATIVE	1-2	Occassional	3-5
9	Faint trace	NIL	NEGATIVE	2-3	Occassional	5-7
10	Faint trace	NIL	NEGATIVE	2-4	1-2	6-8
11	Faint trace	NIL	NEGATIVE	3-5	1-2	4-6
12	Faint trace	NIL	NEGATIVE	2-4	Occassional	5-7
13	Fasit trace	NIL	NEGATIVE	2-3	NIL	3-5
14	NIL	NIL	NEGATUVE	0-1	Occassional	2-4
15	NIL	NIL	NEGATIVE	0-2	NIL	1-3
16	Faint trace	NIL	NEGATIVE	2-5	1-2	2-4
17	NIL	NIL	NEGATIVE	1-2	NIL	3-5
18	Faint trace	NIL	NEGATIVE	3-5	occassional	4-6
19	NIL	NIL	NEGATIVE	0-1	NIL	1-2
20	Faint trace	NIL	NEGATIVE	3-5	Occassional	6-8
21	Faint trace	NIL	NEGATIVE	2-4	Occassional	5-7
22	Faint trace	NIL	NEGATIVE	4-6	2-3	5-7
23	NIL	NIL	NEGATIVE	1-2	Occassional	2-4
24	Faint trace	NIL	NEGATIVE	2-3	Occassional	1-2
25	NIL	NIL	NEGATIVE	0-1	NIL	1-2
26	Faint trace	NIL	NEGATIVE	3-5	2-3	6-8
27	Faint trace	NIL	NEGATIVE	3-5	2-3	6-8
28	Faint trace	NIL	NEGATIVE	2-4	Occassional	5-7
29	Faint trace	NIL	NEGATIVE	4-6	2-4	6-8
30	Faint trace	NIL	NEGATIVE	2-3	NIL	2-4
31	Faint trace	NIL	NEGATIVE	4-5	2-4	5-7
32	Faint trace	NIL	NEGATIVE	2-4	0-1	6-8
33	NIL	NIL	NEGATIVE	2-3	Occassional	2-3
34	NIL	NIL	NEGATIVE	4-6	2-4	6-8
35	NIL	NIL	NEGATIVE	0-1	1-2	2-3

URINE ANALYSIS DETAILS (GROUP B)

S.NO	Albumin	Sugar	Acetone	Puscells/hpf	RBC/hpf	Epithelial cells/hpf
1	NIL	NIL	NIL	0-1	Nil	1-2
2	NIL	NIL	NIL	Occassional	NIL	1-2
3	NIL	Nil	NIL	0-1	NIL	1-3
4	NIL	NIL	NIL	0-1	NIL	1-2
5	NIL	NIL	NIL	0-1	NIL	1-2
6	NIL	NIL	NIL	0-1	Occassional	1-2
7	NIL	NIL	NIL	0-1	NIL	1-3
8	NIL	NIL	NIL	0-1	NIL	1-2
9	NIL	NIL	NIL	0-1	NIL	2-3
10	NIL	NIL	NIL	0-1	NIL	1-2
11	NIL	NIL	NIL	Occassional	NIL	2-3
12	NIL	NIL	NIL	Occassional	NIL	2-3
13	NIL	NIL	NIL	1-2	NIL	2-3
14	NIL	NIL	NIL	0-2	NIL	3-5
15	NIL	NIL	NIL	1-2	NIL	2-3
16	NIL	NIL	NIL	Occassional	NIL	1-2
17	NIL	NIL	NIL	Occassional	NIL	2-3
18	NIL	NIL	NIL	0-1	NIL	1-2
19	NIL	NIL	NIL	Occassional	NIL	1-2
20	NIL	NIL	NIL	0-2	Occassional	1-2
21	NIL	NIL	NIL	0-1	NIL	2-3
22	NIL	NIL	NIL	Occassional	NIL	1-2
23	NIL	NIL	NIL	1-2	NIL	2-3
24	NIL	NIL	NIL	0-1	NIL	1-3
25	NIL	NIL	NIL	0-1	NIL	1-3
26	NIL	NIL	NIL	Occassional	NIL	2-3
27	NIL	NIL	NIL	1-2	NIL	3-5
28	NIL	NIL	NIL	Occassional	NIL	1-2
29	NIL	NIL	NIL	Occassional	NIL	3-5
30	NIL	NIL	NIL	Occassional	NIL	2-4
31	NIL	NIL	NIL	9-1	NIL	1-2
32	NIL	NIL	NIL	1-2	NIL	1-2
33	NIL	NIL	NIL	0-1	NIL	2-4
34	NIL	NIL	NIL	Occassional	NIL	1-2
35	NIL	NIL	NIL	Occassional	NIL	1-2

APPENDIX VIII

FOOD INTAKE OF ADOLESCENT GIRLS (GROUP A)

S.NO	Cereals (g)	Pulses (g)	Leafy vegetable (g)	Other vegatable (g)	Roots & Tubers (g)	Milk & Milk Products (g)	Oil & Fat (g)	Sugar & Jaggery (g)
1	305	12.5	25	NIL	12	50	3.0	15
2	320	9.5	NIL	8	NIL	150	2.0	15
3	275	8.0	NIL	10	NIL	60	1.5	5
4	310	8.0	NIL	8	13	55	2.5	15
5	280	7.0	NIL	NIL	NIL	65	2.5	10
6	310	7.5	15	NIL	10	75	2.0	6
7	295	15.0	20	NIL	12	100	2.5	10
78	285	8.0	NIL	NIL	8	65	2.0	5
9	315	9.0	NIL	12	NIL	100	2.0	10
10	290	11.0	NIL	NIL	10	80	3.0	4
11	280	10.0	15	NIL	13	120	1.0	15
12	275	6.5	NIL	7	NIL	85	2.0	5
13	320	8.0	NIL	NIL	7	65	1.0	10
14	325	7.0	15	NIL	NIL	70	2.0	15
15	285	8.0	NIL	NIL	5	60	1.0	10

FOOD INTAKE OF THE ADOLESCENT GIRLS (GROUP B)

S.No	Cereals 90g)	Pulses (g)	Leafy vegetable (g0	other vegetable (g0	Roots & Tubers (g0	milk & MIlk products (g)	Oil & Fat (g)	Sugar & Jaggery (g)
1	345	12.5	25	NIL	15.0	100	2.0	15
2	350	10.0	NIL	12	NIL	110	1.5	12
3	375	9.0	NIL	15	NIL	115	2.5	18
4	380	9.5	NIL	10	23	120	3.0	4
5	385	8.5	14	NIL	22	100	3.5	15
6	365	8.0	NIL	15	24	90	3.0	6
7	345	16.0	NIL	8	NIL	70	2.5	5
8	355	10.0	30	NIL	NIL	60	2.0	5
9	335	11.5	35	NIL	NIL	55	1.0	15
10	320	15.0	NIL	7	NIL	50	3.5	4
11	290	7.0	NIL	NIL	26	60	2.5	10
12	380	15.0	NILO	10	NIL	40	1.0	6
13	385	9.0	NIL	NIL	22	105	3.0	10
14	370	13.0	NIL	NIL	15	80	3.0	15
15	375	15.0	NIL	NIL	13	120	3.5	10

APPENDIX IX

NUTRIENT INTAKE OF ADOLESCENT GIRLS (GROUP A)

S.No	Calorie (K.cal)	Proteins (g)	Fat (g)	Calcium (mg)	Iron (mg)	B Carotene (Ug)	Thiamine (mg)	Riboflavin (MG)	Niacin (mg)	Ascorbic acid (mg)
1	1350	29	6.5	335	3.6	650	0.39	0.49	6.7	50
2	1455	35	8.0	276	3.45	875	0.56	0.26	8.9	10
3	1315	31	8.5	200	2.73	866	0.84	0.21	10.3	335
4	1400	26	8.0	235	4.15	955	0.78	0.30	5.9	45
5	995	31	9.5	105	4.03	1275	0.40	0.25	12.5	37
6	987	24	6.0	173	3.5	1414	0.37	0.33	9.6	26
7	1065	23	6.5	195	2.0	1680	0.20	0.29	12.2	27
8	1345	27	5.5	265	4.0	2070	0.93	0.24	11.9	39
9	1073	20	7.0	325	5.3	530	0.89	0.19	10.6	63
10	1157	21	8.0	301	5.7	1243	0.78	0.47	8.4	85
11	1045	33	9.0	205	6.9	1793	0.69	0.13	9.8	36.5
12	1164	24	6.0	130	5.5	1073	0.83	0.55	10.4	35
13	1193	25	4.5	150	5.4	1179	0.91	0.17	10.9	34
14	1050	19	7.0	101	1.74	2082	0.96	0.23	9.4	24.5
15	1451	22	5.0	94	2.0	1845	0.97	0.39	12.5	23

DAILY NUTRIENT INTAKE OF ADOLESCENT GIRLS (GROUP B)

S.No	Calories (K.cal)	Proteins (g)	Fat (g)	Calcium (mg)	Iron (mg)	β-Carotene (mg)	Thiamine (Ug)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
1	1521	37	10.0	175	15.1	1954	0.93	0.45	12.6	56
2	1673	39	11	330	14.5	1876	0.95	0.51	11.9	80
3	1750	41	9.5	375	12.7	1946	0.86	0.46	10.7	30
4	1542	43	8.5	349	13.0	1531	0.87	0.32	8.6	27
5	1349	29	7.5	245	9.8	1881	0.79	0.40	8.8	70
6	1245	27	7.0	230	5.4	2051	0.80	0.41	12.4	23
7	1456	28	6.5	495	10.5	2047	0.76	0.52	11.5	60
8	1347	31	6.5	201	8.3	2019	0.78	0.39	12.4	56
9	1476	33	7.5	207	14.0	2179	0.63	0.24	11.9	30
10	1465	30	7.0	280	11.5	2563	0.41	0.31	12.7	46
11	1503	27.5	8.0	140	9.5	1843	0.53	0.19	9.8	51
12	1564	24.5	8.5	266	12.5	1737	0.89	0.26	12.6	49
13	1736	35	9.0	373	14.5	1574	0.97	0.49	9.8	36
14	987	37	6.5	120	8.7	2063	0.86	0.53	10.7	40
15	1001	33	7.0	99	5.0	1746	0.97	0.62	13.1	51

APPENDIX X

STATISTICAL ANALYSIS

Testing the difference between the means of two large sized independent samples : The 't' test is defined by the following formula.

$$t = \frac{\text{Mean difference}}{S}$$

Where Mean difference = $\overline{X}_1 - \overline{X}_2$

$\overline{X}_1$ = Mean of the first sample

$\overline{X}_2$ = Mean of the second sample

$$S = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

Where S_1 = Standard deviation of the fitst sample

S_2 = Standard deviation of the second sample

n_1 = number of samples in the first grouip

n_2 = number of samples in the second group

Example : Testing the difference between the mean heights of group A and group B girls of 13-15 years age.

n_1 - 64 n_2 - 27

$\overline{X}_1$ - 139.3 $\overline{X}_2$ - 141.7

S_1 - 5.2 S_2 - 4.7

(S_1^2)-- 27 $(S_2)^2$ - 22.1

$$s = \sqrt{\frac{(5.2)^2}{64} + \frac{(4.7)^2}{27}} = \sqrt{0.42 + 0.8} = \sqrt{1.22} = 1.1$$

$$t = \frac{\text{Mean difference}}{s} = \frac{139.3 - 141.7}{1.1} = \frac{2.4}{1.1} = 2.2$$

the 't' value os significant at 5% level.