

**DEVELOPING AN INTERACTIVE NUTRITION WEBSITE
AND EVALUATING ITS EFFECTIVENESS AMONG
ADOLESCENT GIRLS**

By

IRENE JOHANNA, D.

(11PN03)

**A THESIS SUBMITTED TO THE
AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND
HIGHER EDUCATION FOR WOMEN
COIMBATORE - 641 043.**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
FOOD SCIENCE AND NUTRITION**

MAY 2013

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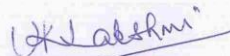
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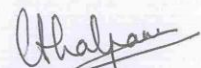
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CERTIFIED AS A BONAFIDE RESEARCH WORK



**Signature of the
Head of the Department**



**Signature of the
Guide**

ACKNOWLEDGEMENT

The investigator expresses her deep sense of gratitude to **God Almighty** for good health, strength, perseverance and wisdom, that has been graciously bestowed upon her during her study, for “I can do everything through Him who gives me strength” (Philippians 4:13).

She expresses her reverential gratitude to **Dr.T.S.K. Meenakshi Sundaram, M.A., M.Phil, Ph.D (Honoris Caussa)** Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for facilitating to complete the study.

The investigator owes her special thanks and gratitude to **Dr.Mrs.Sheela Ramachandran, M.Sc., P.G.Dip (Food Science and Preservation), Ph.D (Avinashilingam)**, Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for providing the necessary infrastructure and resources to accomplish her research work.

The investigator records her sincere gratitude to **Dr.Mrs.T.S.Gowri Ramakrishnan, M.Sc.(Madras), M.Phil., Ph.D.(Avinashilingam)**, Registrar, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for all the help which have provided a smooth basis for the study.

The investigator expresses her heartfelt thanks to **Dr.Mrs.K.Thangamani, M.Sc.,Dip.Ed.,M.Phil.,Ph.D.**, Dean, Faculty of Home Science, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for her help in the conduct of the study.

Heartfelt thanks and deep sense of gratitude are expressed to **Dr.U.K.Lakshmi, M.Sc., Dip.Ed., M.Phil.(Madras), Ph.D.(Avinashilingam)**, Professor and Head, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, for her constant encouragement, valuable advice and extensive discussion around the study.

With glowing sense of gratitude and honesty, the investigator places her sincere and profound gratitude to her supervisor **Dr.Mrs.C.A.Kalpana, M.Sc. (Madras),B.Ed.(Annamalai), M.Phil.(MotherTheresa), Ph.D.(Avinashilingam Deemed University)**, Associate Professor, Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, whose words always inspired to a higher level of thinking and for her unreserved help and guidance from finding an appropriate subject in the beginning to the process of writing thesis. Without her kind and patient instruction, it would be impossible to finish this study.

Her acknowledgement is due to all the students who participated in the study with whose willingness and co-operation the study was made possible.

The investigator expresses her heartfelt gratitude to her lovable parents **Mr.E.David Vijayaraja**, and **Mrs.Sheila David** who provided a carefree environment to concentrate on the study and for their constant prayer, care and unflagging love and concern throughout the endeavour, without whom this work would not be possible.

The investigator expresses her sincere gratitude to **Mr.Emmanuel Ravikumar Kingston**, her brother-in-law and Managing Director of **JnJ Web Solutions**, **Mrs.Sherine Susanna Emmanuel**, her sister and web designer, and **Mr.Rajasekar**, web programmer for their constant encouragement and help rendered in developing the website successfully.

The investigator with deep gratitude places a special word of thanks to **Ms.Jania Kristen Emmanuel** and **Mr.M.Peter Shalom**, for their precious care, support and encouragement throughout the study.

Last but not least, the investigator also expresses her special thanks to all her friends and well wishers for their support and inspiration.

CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APPENDICES	
I	INTRODUCTION	1
II	REVIEW OF LITERATURE	5
	A. Importance of Nutrition to Adolescents	5
	B. Dietary Pattern of Adolescents	7
	C. Nutritional Problems of Adolescents	11
	D. Impact of Nutrition Education	15
	E. Role of Internet in Nutrition Education	17
III	METHODOLOGY	21
	A. Selection of Area	21
	B. Selection of Sample	21
	C. Formulation of Interview Schedule and Questionnaire	22
	D. Assessment of Socio-economic Background, Internet Use and Nutritional knowledge	24
	E. Development of Nutrition Website	24
	F. Implementation of Nutrition Education through the developed Nutrition Website	32
	G. Evaluation of the Impact of Nutrition Education	32
	H. Analysis of data	34
IV	RESULTS AND DISCUSSION	35
	A. General information of selected adolescent girls	35
	B. Health status of selected adolescent girls	40
	C. Dietary pattern of selected adolescent girls	42
	D. Internet usage of selected adolescent girls	53
	E. Impact of nutrition education on selected adolescent Girls	58
	F. Evaluation of the Nutrition Website	64
V	SUMMARY AND CONCLUSION	66
	BIBLIOGRAPHY	
	APPENDICES	

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
I	AGE OF SELECTED ADOLESCENT GIRLS	35
II	SOCIO-ECONOMIC BACKGROUND OF SELECTED ADOLESCENT GIRLS	38
III	METHODS FOLLOWED TO STAY HEALTHY	40
IV	ADOLESCENT GIRLS ATTENDING DIET COUNSELING	41
V	SOURCES OF NUTRITION INFORMATION FOR THE ADOLESCENT GIRLS	42
VI	TYPE OF DIET CONSUMED AMONG ADOLESCENT GIRLS	43
VII	MEAL PATTERN OF SELECTED ADOLESCENT GIRLS	44
VIII	MEAL SKIPPING PATTERN AMONG SELECTED ADOLESCENT GIRLS	45
IX	REASONS FOR SKIPPING MEALS BY SELECTED ADOLESCENT GIRLS	45
X	FREQUENCY OF SKIPPING THE MEAL BY SELECTED ADOLESCENT GIRLS	46
XI	COMPENSATION FOR SKIPPED MEALS BY SELECTED ADOLESCENT GIRLS	47
XII	FOOD FREQUENCY AMONG SELECTED ADOLESCENT GIRLS	48
XIII	FOOD PREFERENCE AMONG SELECTED ADOLESCENT GRLS	52
XIV	ACCESSING INTERNET BY SELECTED ADOLESCENT GIRLS	54
XV	TIME DURATION SPENT IN BROWSING	55
XVI	PURPOSE OF USING INTERNET	56

XV	TIME DURATION SPENT IN BROWSING	55
XVI	PURPOSE OF USING INTERNET	56
XVII	ACCESSING NUTRITION WEBSITE BY SELECTED ADOLESCENT GIRLS	57
XVIII	ACCESSING ONLINE DIET COUNSELING BY SELECTED ADOLESCENT GIRLS	57
XIX	PREFERENCE FOR NUTRITION LEARNING	58
XX	DIFFERENCES IN THE NUTRITIONAL KNOWLEDGE LEVELS BETWEEN THE SELECTED NUTRITION AND NON-NUTRITION ADOLESCENT GIRLS	59
XXI	CHANGES IN THE NUTRITIONAL KNOWLEDGE	62
XXII	INFORMATION OBTAINED FROM THE OPINIONNAIRE	64

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1	RESEARCH DESIGN	23
2	HTML PAGE	30
3	CSS SHEET	31
4	AGE OF SELECTED ADOLESCENT GIRLS	36
5	DIFFERENCES IN THE NUTRITIONAL KNOWLEDGE LEVELS BETWEEN THE SELECTED NUTRITION AND NON-NUTRITION ADOLESCENT GIRLS	60
6	CHANGES IN THE NUTRITIONAL KNOWLEDGE	63

LIST OF PLATES

PLATES NO.	TITLE	PAGE NO.
1	ASSESSMENT OF SOCIO ECONOMIC BACKGROUND AND NUTRITIONAL KNOWLEDGE	25
2	STUDENTS ACCESSING THE NUTRITION WEBSITE	33

LIST OF APPENDICES

APPENDIX	TITLE
NO.	
I	INTERVIEW SCHEDULE TO ELICIT SOCIO ECONOMIC BACKGROUND AND USE OF INTERNET
II	QUESTIONNAIRE TO ASSESS NUTRITIONAL KNOWLEDGE
III	WEB PAGES OF THE NUTRITION WEBSITE
IV	TOTAL SCORES OBTAINED BY THE ADOLESCENT GIRLS BEFORE AND AFTER NUTRITION EDUCATION

I INTRODUCTION

Adolescence is a period characterized by physical, psychological and social changes and generally it is classified as: early adolescence between 10 to 14 years and late adolescence between 15 to 19 years. Adolescent is defined by World Health Organization (2013) as a person between the ages of 10 to 19 years.

India is the second populous country in the world with a total population of over 1081 million. Adolescents form a large section of the population - 225 million, accounting to 23 percent. The health of a nation largely depends on the health of its people – especially adolescents or youth. Profound biological, psychological and social changes occur in the adolescents and their health and welfare should be fostered as today's adolescents are the adults of tomorrow (Swaminathan, 2013).

During the teen years, adolescents experience changes in their physical development at a rate of speed unparalleled since infancy. Physical development includes rapid gain in height and weight, development of secondary sex characteristics and continued brain development (Ruffin, 2009).

Normal growth and development are influenced by nutritional status because the hormones responsible for linear growth, alteration in body composition, and sexual development is nutritionally regulated (Pamela, 2009).

The adolescent growth spurt differs in individuals and it takes 2 to 4 years to complete. The average height velocity is 5 to 6 cm/year during adolescence; Girls, on an average, begin their pubertal growth spurt at age 9 years (Spencer, 2009).

The peak rate of growth for weight is 12.5 years for girls and 13.9 years for boys. Boys and girls grow at different rates during adolescence (Sigelman et al., 2012).

Increase in weight slowly, but steadily, accelerates until a sudden rapid increase in weight velocity marks the onset of the pubertal spurt in weight.

Bone mass doubles between the onset of puberty and young adulthood. Approximately 25 percent of peak adult bone mass is acquired during the two years of peak adolescent skeletal growth (Cameron et al., 2012).

The maximal rate of calcium accretion in the skeleton occurs at the ages 11 to 14 years in girls. In adolescents there is a linear relationship between dietary calcium intake and calcium retention (Duggan et al., 2008).

Total nutrient needs are higher during adolescence than any other time in the life cycle. Nutrition and physical growth are integrally related; optimal nutrition is a requisite for achieving full growth potential. Nutrition is also important during this time to help prevent adult diet-related chronic diseases, such as cardiovascular disease, cancer, and osteoporosis (Troiano et al., 2010).

Food intake of adolescents is influenced by psychosocial factors; peers and popular culture, including the mass media and advertising, significantly affect dietary patterns (Edelstein et al., 2009).

During adolescence, food habits change drastically. Diets of today's preadolescents and adolescents are low in fruits, vegetables, dairy products, whole grains, and high in total fats, saturated fats and added sugars (Krebs, 2009).

College students tend to engage in a number of problematic eating behaviours, including unhealthy dieting, skipping meals, high intake of fast foods, low intake of fruits and vegetables, and minimal consumption of dairy products (Huang et al., 2008).

College students have minimal knowledge of healthy eating behaviours and nutritional requirements. They have low baseline knowledge of nutrients, food labels, and the groups of the food guide pyramid (Matvienko et al., 2009).

Nutritional problems among adolescents are common throughout the world. Nutritional problems not only affect their growth and development but also in future would affect their livelihood as adults. The common nutritional problems among adolescents are undernutrition, anaemia, overweight or

obesity, polycystic ovarian syndrome, eating disorders and metabolic syndrome (Gupta et al., 2009).

Forty seven per cent adolescent girls in India are underweight with a body mass index of less than the prescribed level of 18.5, said the UNICEF Global Report card on Adolescents 2012. Undernutrition leaves adolescents vulnerable to disease and the next generation of our country will be affected if adolescent girls who would be future mothers would have ill health and poor nutritional status. Hence, it is essential to impart nutrition education to adolescent girls (Ankita, 2012).

An important consideration for targeting nutrition education to college students is that they are at a crucial stage in their development as there is transition from parental control over lifestyle behaviours to assuming responsibility for their own health choices (Cousineau et al., 2008).

Nutrition health education is an effective method to improve the dietary behaviour of university students (Qiaoling et al., 2009).

Nutrition education is widely used for a range of population groups as a medium to deliver healthy diet and nutrition information; however, this type of intervention is still rarely implemented for college students. While there are various modes of nutrition education interventions, their effectiveness on eating habits remains unclear (White et al., 2009).

Among adolescents, the Internet has become indispensable for various instrumental purposes. Ninety three per cent of adolescents in the age group of 12 to 17 years go online, as do 93 per cent of young adults aged 18 to 29 years. Over the past ten years, teens and young adults have been consistently the two groups most likely to go online, even as the internet population has grown (Amanda et al., 2010).

Use of Internet is an innovative way to address the problem of poor nutrition on college campus. Indeed, the Internet has become central to most students' educational experiences and offers an exciting opportunity to engage

students through interactive multimedia programs. It was also observed that many college students own a personal computer and many browse the internet daily (Jones, 2008).

One means to promote healthy dietary habits is health communication. In the last decades, several potentially important new channels for health communication have emerged, such as interactive computer programs, mobile technologies like mobile phones with text messaging and hand-held computers, interactive television, and maybe most importantly, the internet with its World Wide Web (WWW) and e-mail applications (Oenema et al., 2009).

Computer-tailored nutrition education is an innovative and promising tool to motivate people to make healthy dietary changes. Interactive technology like Internet and the World Wide Web offers good opportunities for the application of computer-tailored nutrition education (Johannes et al., 2008).

Providing students nutritional information is critical to dietary change. The most effective distribution channel is World Wide Web, which is a top choice in this era of digital technology and is convenient to use and capable of reaching a broad audience (Gross et al., 2009).

With this in view, the following objectives are set for the present study titled **“Developing an Interactive Nutrition Website and Evaluating its effectiveness among Adolescent Girls”**.

Objectives of the study

To

- Develop an interactive website on nutrition for adolescent girls
- Assess the nutritional knowledge of selected adolescent girls
- Impart nutrition education using the developed website
- Evaluate the impact of nutrition education on nutritional knowledge.

II REVIEW OF LITERATURE

The review of literature for the study entitled '**Developing an Interactive Nutrition Website and Evaluating its effectiveness among Adolescent Girls**' is reviewed under the following heads.

A. Importance of Nutrition to Adolescents

B. Dietary Pattern of Adolescents

C. Nutritional Problems of Adolescents

D. Impact of Nutrition education

E. Role of Internet in Nutrition education

A.IMPORTANCE OF NUTRITION TO ADOLESCENTS

The adolescent years are characterized by dramatic growth and development beginning with the onset of puberty and continuing throughout the teen years. Significant health and nutritional risks occur during adolescence as a result of increased need for energy and nutrients, increasing financial independence, and peer pressure (Kaufman, 2008).

Nutrition during adolescence is one of the vital aspects as adolescence comprises the second and last growth spurt period and adolescents are susceptible to develop faulty eating behaviour leading to malnutrition (Huebner, 2010).

Adolescence is a vulnerable period in human life cycle when nutritional requirements increase due to the adolescent growth spurt. Adolescence, one of the nutritional stress periods of life with profound growth, comes with increased demands for energy, protein, minerals and vitamins (Chandan, 2009).

It is important for adolescents to consume enough calories to support normal growth and development without promoting excessive weight gain (United States Department of Agriculture, 2009).

During adolescence, physical changes affect the body's nutritional needs, while changes in one's lifestyle may affect eating habits and food

choices. Adolescent nutrition is therefore important for supporting the physical growth of the body and for preventing future health problems (Kurz, 2008).

Adolescence is a period of rapid growth. Adolescents experience dramatic physical growth and development during puberty, which turns appreciably, increases their requirements for energy, protein, and many vitamins and minerals. It is a timely period for adoption and consolidation of sound dietary habits. Many habits acquired during adolescence will last a lifetime (Ammerman et al., 2010).

Adequate nutrition and healthy eating and physical exercise habits at this age of adolescence are foundations for good health in adulthood (Kumar, 2012).

Adolescents may represent a window of opportunity to prepare nutritionally for a healthy adult life. It may also be a timely period to shape and consolidate healthy eating and lifestyle behaviors, thereby preventing or postponing the onset of nutrition related chronic diseases in adulthood (Marino et al., 2008).

Adolescence is a particularly unique period in life because it is a time of intense physical, psychosocial, and cognitive development. Increased nutritional needs at this juncture relate to the fact that adolescents gain up to 50 per cent of their adult weight, more than 20 per cent of their adult height, and 50 per cent of their adult skeletal mass during this period (WHO, 2011).

Approximately 40 per cent of peak bone mass in girls is accumulated in this short stage of the life cycle. Bone acquisition is accelerated within the genetic potential by lifestyle choices, including diet, eating behavior, and exercise (Matkovic et al., 2009).

A positive energy balance from macronutrients is important during adolescence for synthesis of bone and also the muscles that exert contractile forces on bone, thereby influencing bone modeling (Cadogan et al., 2008).

Caloric and protein requirements are maximal during adolescence. Increased physical activity, combined with poor eating habits and other considerations, e.g. menstruation, contribute to accentuating the potential risk for adolescents of poor nutrition (Judith, 2011).

Inadequate nutrition during puberty results in suboptimal peak bone mass, which, in turn, increases the risk of fracture later in life. Development of a higher peak bone mass during adolescent years protects against postmenopausal osteoporosis (Martin et al., 2008).

Adolescence is a critical time for young women, building the foundation for successful reproduction and a healthy adulthood and later life. Young women must enter adulthood with good nutritional stores to remain strong and healthy throughout their child-bearing years and into old age. Good nutrition is especially important for adolescent girls to meet future needs of pregnancy and breastfeeding (Sigelman et al., 2012).

During the period of puberty, the body requires high calories and nutrients like protein, calcium, iron, folate and zinc. Iron and calcium are particularly important nutrients during adolescence (Parimalavalli et al., 2011).

Adolescent girls also need additional requirements of iron, upto fifteen per cent to compensate the monthly physiological blood loss. The rapid growth occurs during adolescence and demands extra nutritional requirements (Banera, 2008).

B. DIETARY PATTERN OF ADOLESCENTS

The pattern of nutritional intake in Asian Indians is diverse and influenced by several factors including socio-economic status, region, religion, and easy availability of certain food groups. Nutritional transition is a shift of nutritional intake patterns from basic to a situation that adversely affects health (Wasir et al., 2008).

Driven by aggressive advertising practices, relatively low cost, and increasing purchasing power, adolescents are increasingly consuming high

saturated-fat snacks, refined carbohydrates, sweetened carbonated beverages, and diets low in polyunsaturated fatty acids (PUFAs) and fibers (Misra, 2008).

In a study among adolescents and young adults of New Delhi numbering 1236, all the subjects had a higher absolute (g/d) intake of fat than the RDA. Also, proportionately more daily percentage energy was being derived from dietary fats. Approximately 1.8 cans of cola per week (540 ml/week) per person consumption were noticed in the subjects. The study highlights a markedly disproportionate consumption of dietary macronutrients and micronutrients (Nidhi et al., 2010).

Girls were more likely than boys to be consuming 30 per cent or less of their total energy from fat but were far less likely to be consuming the recommended amounts of calcium or grains. These sex differences may be the result of higher prevalence rates of dieting for weight-control purposes among the girls than among the boys (Neumark, 2009).

The calorie and protein intake of the adolescent girls is much lower among adolescent girls from the lower socio economic group. Even in the comparatively better economic status girls, the intake fell short of requirement, which could be attributed to the concern for maintaining a slim look (Sharma et al., 2008).

Breakfast has been regarded as the most important meal of the day, in part because of its nutritional benefits, but the prevalence of skipping breakfast was higher in adolescents, especially girls, than in children (Susan et al., 2010).

Skipping breakfast occur because of a limited knowledge about health and nutrition, lack of time to eat or prepare breakfast, unavailability of foods for breakfast, or weight concerns, which was seen mainly among adolescent girls (Malinauskas et al., 2008).

Daily breakfast intake is associated with a lower likelihood of overweight and obesity among urban Indian adolescents, but 30 per cent of

adolescents skipped their breakfast daily in a study conducted in Delhi numbering 1814 adolescents (Monika et al., 2012).

Despite the enormous health and nutritional benefits that could be derived from the consumption of fruits, studies have shown that most adolescents do not consume fruits as per the recommended daily intake. Price scores as well as satiety scores were the significant variables found to hinder adolescents' fruit intake (Mintah et al., 2012).

Large proportions of children do not fulfill the World Health Organization recommendation of eating at least 400 gram of fruit and vegetable per day. The potential determinants for fruit and vegetable intake are time costs, lack of taste guarantee, satiety value, and access to unhealthy foods (Krolner et al., 2011).

The most common description of the dietary practices currently adopted during adolescence consists of fat, sugar, and sodium-rich diets, with little addition of fruits and vegetables (Denise, 2008).

In a study among 116 adolescents aged 15-17 years in Szamotuly, Poland, more than 50 per cent of adolescents preferred more salty meals. They most often declared that they eat sweets and salty snacks daily (Hoffmann et al., 2012).

Consumption by 12 to 17 year old adolescents of food prepared away from home has increased. This increase has resulted from a more than doubling of the energy consumed at restaurants and fast food establishments. Greater consumption of foods prepared away from home may be associated with poorer diet quality among adolescents (French et al., 2008).

College students tend to engage in a number of problematic eating behaviours, including unhealthy dieting, skipping meals, high intake of fast foods, low intake of fruits and vegetables, and minimal consumption of dairy products (Kaur et al., 2008).

Higher scores for dietary patterns characterized by higher consumption of take away food, meat, confectionary and soft drinks were found among adolescents. These patterns were also associated with higher per cent of energy from carbohydrates as well as lower nutrient densities of several vitamins and minerals (Richter et al., 2012).

Adolescents have the highest intake of added sugars than any other age group; approximately 40 per cent of added sugars are consumed in carbonated soft drinks (Briefel et al., 2008).

Unsatisfactory meal consumption pattern was more frequent among girls (Estima et al., 2009).

A study conducted among African Mexican adolescent girls in America numbering 586, 27 per cent consumed one or more servings of sweetened beverages per day and 15.7 per cent consumed three or more servings per day, and 75 per cent consumed three or more snacks per day. Only 49 per cent of participants met the recommended three servings of dairy foods per day (Youfa et al., 2010).

Adolescents consume more carbonated soft drinks than they do fruit juices or milk. Consumption of soda and fruit drinks among adolescent girls doubled and milk consumption decreased. Displacement of milk by high sugar beverages reduces consumption of protein, calcium, vitamin B₂, B₁₂ and D (Xie et al., 2008).

Self- purchasing foods from fast food outlets or convenience stores is common among adolescents. Close proximity (less than 1 km) to the nearest fast- food outlet or convenience store in the home neighbourhood increased the likelihood of food purchasing from these food establishments at least once per week by adolescents (Irwin et al., 2012).

Most adolescents eat meals and snacks away from home. Adolescents who ate at a fast food restaurant at least three times in the past week had energy intakes about 40 per cent higher than adolescents who did not eat fast food.

Frequency of fast food consumption also is inversely related to daily servings of vegetables, fruit, and dairy products (French et al., 2009).

Out of 2765 students in Avinashilingam Deemed University for Women, Coimbatore, Tamil Nadu, 73 per cent consumed fast foods. Only 27 per cent did not consume fast foods. The most preferred items were chocolates, candies, puffs followed by chat items, cool drinks, ice creams and pastries. Adolescents are negatively associated with healthy food and positively associated with junk foods (Vasanthamani et al., 2009).

Brache et al. (2008), stated that the improper dietary pattern of adolescent girls as misinformation about food values, eating in fast food restaurants, skipping meals, consuming snacks, and foods high in sugar and going on fad dieting.

Eating due to emotions and stress were common in adolescents which lead to obesity (Ozier et al., 2008).

High peer pressure and craze to match the latest trends lead adolescents to eat pizza, burgers, aerated drinks, chocolates, which have a long-term effect of obesity, hyperlipidemia, and sexual maturation delays (James et al., 2008).

C.NUTRITIONAL PROBLEMS OF ADOLESCENTS

Adolescent nutritional problems are common throughout the country. Some people lack adequate food while some people though have adequate amount of food yet make its poor choices. Because of these reasons, nutritional problems not only affect their growth and development but also in future would adversely affect their livelihood as adults (Patil et al., 2009).

Adolescents increasingly seem to adopt lifestyles that negatively affect their nutritional and health status and therefore substantially increase their risk for premature development of chronic diseases like cardiovascular diseases, diabetes, metabolic syndrome, osteoporosis and certain cancers (Koplan et al., 2008).

Occurrence of series of nutritional problems like undernutrition, anemia, vitamin A deficiency, iodine deficiency and overweight or obesity develops in adolescents (Shivaramakrishna et al., 2011).

Poor eating habits and limited physical activity of adolescents can likely increase the risk for osteoporosis, obesity, hyperlipidemia, diabetes, and cancer later in life (Patil et al., 2009).

In a country like India with varying social customs and common beliefs among females, there is a high prevalence of malnutrition amongst adolescent girls. Varying studies have revealed on an average adolescent girls in India, suffer gross nutrition adequacy (Choudhary et al., 2009).

In general adolescent girls are the worst sufferers of the ravages of various forms of malnutrition because of their increased nutritional needs and low social power. A nutritional deficiency has far reaching consequences, especially in adolescent girls. If their nutritional needs are not met, they are likely to give birth to undernourished children, thus transmitting under nutrition to future generation (Choudhary, 2008).

Adolescents have specific health and development needs, and many face challenges that hinder their well-being. Prevalence of under nutrition was common among the girls in the late adolescent group (Yogesh, 2011).

In girls, poor nutrition can delay puberty and lead to the development of a small pelvis. Malnourished adolescent girls who have babies at a young age are more likely to experience, and will be less able to withstand, complications because the body has not yet reached maturity (Das et al., 2009).

Nutritional anaemia is one of India's major public health problems. Adolescence is a vulnerable period in the human life cycle for the development of nutritional anaemia. Anaemia in adolescent girls contributes to future maternal and fetal mortality and morbidity and high infertility rates (Kulkarni et al., 2012).

A review of Indian studies on anaemia in adolescent girls revealed that more than 70 per cent of adolescent girls in low income communities had haemoglobin levels less than 110 g/L. When World Health Organization cut off of 120 g/L was applied, the prevalence was even higher (80-90 per cent) (Abel et al., 2008).

Iron deficiency is one of the major nutritional problems which affect adolescents. The prevalence of anemia in the adolescent age group is reported to be 27 per cent in developing countries and 6 per cent in developed countries. A study in Srilanka indicated that 59 per cent of the school girls, aged 14-18 years, have low iron stores (Ratna et al., 2008).

Nutritional anaemia in adolescent girls can have an adverse effect on educational performance, productivity and well-being (Malhotra et al., 2009).

The clinical manifestations of anaemia are anorexia, headache, breathlessness on exertion, lethargic feeling, pale conjunctiva, pale but uncoated tongue, spoon shaped nails (Tarvinder et al., 2013).

More than one out of three adolescents is currently overweight or at risk for becoming overweight. Many of these adolescents experience compromised mental and physical health and are much more likely to face serious and chronic illnesses as adults (Goldschmidt et al., 2008).

The consequences associated with overweight are increased risk for cardiovascular disease, hypertension, diabetes mellitus type II, and, as more recently observed, hepatic steatosis and psychosocial disturbances resulting from social stigmatization (Lira et al., 2010).

The increase in obesity in adolescents has been attributed to a dietary shift away from fruits and vegetable towards fats and simple carbohydrate and to reduced energy expenditure in physical activity (Blössner et al., 2010).

The public health burden of eating disorders, including bulimia nervosa, anorexia nervosa, and binge eating disorders in adolescents is increasing (Treasure et al., 2010).

More than 75 per cent of eating disorder cases begin during adolescence. Anorexia nervosa has been reported in approximately one per cent, and bulimia nervosa, in up to 5 per cent of adolescent females (Hay et al., 2008).

Approximately 20 per cent of adolescents with anorexia nervosa experience amenorrhea prior to weight loss. Amenorrhea of six months or longer has been associated with significant loss of bone density, failure to attain peak bone mass, and increased risk of osteopenia, premature osteoporosis and fractures (Yager et al., 2008).

Polycystic ovary syndrome (PCOS) is a common endocrine metabolic dysfunction closely associated with insulin resistance and obesity (Petermann et al., 2012).

PCOS is the most common cause of menstrual dysfunction and hyperandrogenism in adolescents. It is estimated that five to ten percent of reproductive age women have PCOS, and this includes adolescents (Blank, 2008). The incidence of PCOS among adolescents is estimated to be between 11 and 26 percent and about 50 percent of them are overweight (Driscoll, 2008).

PCOS is a common disorder, but the diagnosis may be overlooked during adolescence, as irregular menses with anovulatory cycles, obesity, and acne are frequent in adolescent women. It is the common cause of infertility. It occurs in overweight adolescents (Battaglia et al., 2008).

D.IMPACT OF NUTRITION EDUCATION

Nutrition promotion is about the promotion of healthy eating and drinking habits. Its purpose is to change people's food consumption behaviour. Health education programme must promote and facilitate voluntary application of health knowledge to health enhancing actions in daily life. The goals of health education for students are to acquire and evaluate health related

information, make knowledge decisions to improve their health, apply their decisions to improve their physical, mental and social well-being and their peers, families and communities (Subba, 2010).

Educating adolescents plays an important role in generating social understanding and acceptance of broader interventions to improve nutrition (Eyles et al., 2012).

Nutrition education is an important measure to improve dietary habits and food choices of the adolescent girls, as poor dietary habits and ignorance are the main reason for poor nutritional status of the adolescent girls. It would not only improve the health of adolescent girls, but future generation will also be influenced, as adolescent girls are would be mothers (Gupta et al., 2009).

Nutrition education can be used as an effective measure to bring about favourable and significant changes in the dietary pattern of adolescent girls who are future mothers and who would be responsible for bringing nutritious balanced diet to their family members (Sharma et al., 2009).

The modes of intervention used for nutrition education are web-based education, dietary supplements, and educational lectures. The methods of lecture used are traditional lectures combined with hands-on activities, debates on nutritional treatments and cooking classes (Lua et al., 2012).

Well-designed and effectively implemented nutrition education can motivate those participating to change dietary behaviors and provide them with the knowledge and skills to make healthy food choices in the context of their lifestyles and economic resources (Howerton et al., 2008).

Significant and beneficial changes in dietary habits have been found for college students after the implementation of nutrition interventions via various techniques (Silva, 2009).

Interventions aimed at adolescents should be adapted so that, in addition to incorporating stage-matched printed educational materials, they also include other strategies for motivating them to adopt a healthy diet. It is also important

to involve the social network that surrounds adolescents, in order to provide support for behavioral changes, and consider the duration of the nutritional intervention and the assessment measurements that can identify small changes in dietary habits (Toral et al., 2012).

School based nutrition education interventions are effective for reducing overweight and obesity and for increasing the consumption of fruits and vegetables among children and adolescents (Jonas et al., 2011).

A nutrition education programme through group contacts and lecture cum discussion method using charts, leaflets, posters and demonstrations was carried out involving sixty adolescent girls in Solan, Himachal Pradesh. The results revealed that nutrition education was effective in increasing the level of nutrition knowledge as well as nutrient intake (Tarvinder, 2008).

According to Brinley et al., (2008), an intervention with educational materials, lectures, and food tasting for six weeks resulted in advances through the stages of change for about 27 per cent of the schoolchildren.

The nutrition education improved the nutrition knowledge of university students and changed their nutrition attitude. In a study conducted, the students in the nutrition education group got a higher correctness rate of answering the question on knowledge and attitude than ones in the control group (XiaoHui et al., 2011).

A study was conducted on 702 adolescent girls in Delhi which revealed an inadequate consumption of several nutrients. After imparting nutrition education, the girls showed changes in dietary behaviour and significant improvement in the intake of food groups and nutrients (Shrivastar et al., 2010).

Among 160 non-medical specialty college students in China there was a significant improvement in the level of nutrition knowledge among the university students, the nutrition attitudes of University students were better

and the dietary behaviour appropriately improved after nutrition education (Qiao et al., 2009).

Teaching on nutrition was effective in increasing the nutritional knowledge level and improving the nutrition attitude and practice (Miejnru et al., 2010).

E. ROLE OF INTERNET IN NUTRITION EDUCATION

It is estimated that nearly more than 500 million people throughout the world use the Internet and growth among new users shows no sign of slowing (Telcordia, 2011).

In the last decades, several potentially important new channels for health communication have emerged, such as interactive computer programs, mobile technologies like mobile phones with text messaging and hand-held computers, interactive television, and maybe most importantly, the Internet with its World Wide Web (WWW) and e-mail applications (Tate et al., 2008).

The World Wide Web has changed health communication in several ways. The WWW enables a swift and inexpensive distribution of content information to help professionals prepare and develop nutrition education materials. The WWW can be used as a channel to easily distribute nutrition education information and to make nutrition education materials more available and accessible, and the WWW is a preferred source of health information for many consumers (Dillen et al., 2009).

WWW is used in nutrition education to provide an easily accessible source of information on nutrition and health, determinants of nutrition behaviours, and evidence- based nutrition education strategies. It is used as a channel for nutrition educators to distribute generic nutrition education information to a large potential audience worldwide (Ritterband et al., 2008).

Computer-tailored nutrition education is more likely to be read, processed more intensively and appreciated better than more general intervention materials (Mangunkusumo et al., 2009).

Computers combine numerous communication methods, such as text, sound, still images and animation. This increases the possibilities of developing teaching tools that are challenging, enjoyable and attractive for users, and thus computers are a valuable addition to nutrition education (Kolasa et al., 2008).

The many nutrition and health portals available on the web can help people start to find nutrition and health information tailored to their personal needs. The ongoing development of wireless Internet will make Internet access possible almost anywhere and anytime. People have more opportunities to get web-based nutrition information where and when they need it (Campbell et al., 2009).

The Internet offers a plethora of communication channels - including the World Wide Web (WWW), E-mail, news-groups, chat rooms, instant messaging, file exchange services - that have the potential to improve the effectiveness, efficiency, and reach of almost all aspects of health education (De Vries et al., 2009).

Scholars and educators have recognized the need to create wide-reaching programs for adolescents emphasizing skills-building for healthy nutrition and weight control. The internet has potential to serve this function by providing nutrition information to a large number of adolescents very quickly, with little cost compared to traditional methods of health communication such as doctor visits, books, printed materials or community programs (Gray et al., 2008).

A new and evolving area in the promotion of dietary behavioural change is 'e-learning', the use of interactive electronic media to facilitate teaching and learning on a range of issues including health (Harris et al., 2011).

Adolescents use the internet to obtain health information, although this may be a small portion of their total time spent online. Crutzen *et al.*, (2009) reported that among the 93 per cent of all U.S. teens (age 12 to 17) online, 31 per cent have searched the internet for information on general health, dieting, or physical fitness.

Scholars have suggested that such web-based nutrition education are promising because the adolescence age group spends considerable time online and might be open to new ways of presenting information and education materials using that medium (Jessica et al., 2011).

In a study among 400 college students in United States, Cousineau *et al.*, (2011) predicted that a web-based interactive nutrition program may offer colleges a viable, cost-effective nutrition education tool which could serve as an important adjunct to health services and campus programming.

An Internet-based nutrition and physical activity education program was given to 139 college students from 6 universities in United States. The results revealed that the internet-based nutrition education was effective for promoting changes in health behaviours (Franko et al., 2008).

Internet-based, computer-assisted health education programme improved women's body satisfaction in a study among 43 female adolescents in United States (Winzelberg et al., 2009).

A web-based intervention using an online course system with email messages, posted information, and behaviour checklists with tailored feedback was carried out involving 294 college students in United States. After nutrition intervention, there was an increased self-regulation and self-efficacy in consuming 3 servings/day of dairy products (Poddar et al., 2010).

Online intervention for weight gain prevention was feasible and effective in a study among 159 first year college students in United States who were given an online intervention to reduce adult obesity (Gow et al., 2010).

The efficacy of two computer-based programs was tested with Latina college women (N=64). Compared with participants in the control group, intervention participants improved their motivation to eat fruits and vegetables and to participate in physical activity (Franko et al., 2012).

In the study on the effects of web-based nutrition education, Oenema *et al.* (2009) found short-term changes in a number of mediators of nutrition

behaviours, such as awareness of favourable intake levels and motivation to make dietary changes.

A sixteen week, Internet-delivered program produced a reduction in BMI z-score in adolescent boys and girls, in a study conducted among 80 adolescents in San Diego (Angela et al., 2008).

The cluster-randomized study among 486 adolescents in schools of Netherlands indicated that an intervention combining Internet-tailored nutrition advice with dietary counseling by a nurse among adolescents resulted in better knowledge of the recommended vegetable intake levels and awareness of inadequate fruit intake (Johan et al., 2009).

The use of computers to deliver education and support strategies has been shown to be effective in a variety of conditions. The addition of computer-based technology to weight loss interventions led to statistically greater weight loss (Reed et al., 2012).

Computer tailoring is currently one of the most promising and innovative approaches in nutrition education. The Internet, and especially the World Wide Web, is regarded as a very promising medium for health promotion interventions in general (Brug et al., 2009).

III METHODOLOGY

The methodology adopted for the present study titled “**Developing an Interactive Nutrition Website and Evaluating its effectiveness among Adolescent Girls**” is described under the following headings

- A. Selection of area
- B. Selection of sample
- C. Formulation of Interview Schedule and Questionnaire
- D. Assessment of Socio economic Background, Internet Use and Nutritional knowledge
- E. Development of Nutrition Website
- F. Implementation of Nutrition Education through the developed Nutrition Website
- G. Evaluation of the Impact of Nutrition Education
- H. Analysis of Data

A. SELECTION OF AREA

Nutrition and health education is valid for college students to help them raise their nutritional knowledge and adopt good dietary practices (Zouping et al., 2009).

As a student of Food Science and Nutrition, the investigator felt the need to create an informative website on adolescent nutrition and evaluate its effectiveness among adolescent girls and hence Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore where she is studying was selected as the study area.

B. SELECTION OF SAMPLE

Adolescence is a period of rapid linear growth, altered body composition, reproductive maturation and psychosocial development. Nutrient

requirements are increased to meet the demands of growth and development (Edelstein et al., 2009).

Adolescents are the biggest consumers of the Internet. They are the early adopters of this technology (Bargh et al., 2008).

In this context, 200 adolescent girls in the age group 17-19 years which included 100 Non-Nutrition students and 100 Nutrition students belonging to I, II and III year undergraduate courses were selected from the Department of Food Science and Nutrition, Economics, English and Computer Science. The research design of the study is presented in Figure 1.

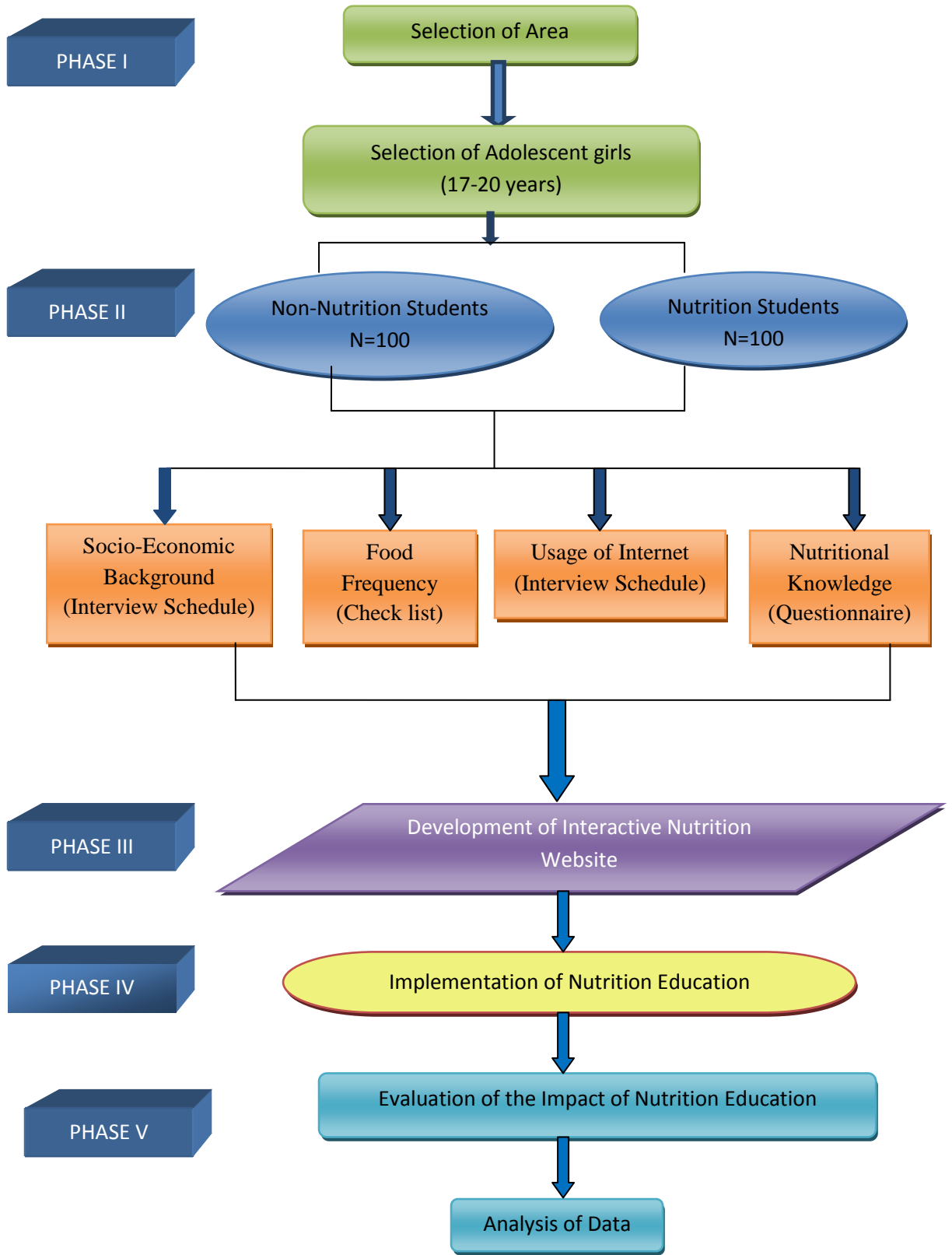
C. FORMULATION OF INTERVIEW SCHEDULE AND QUESTIONNAIRE

An Interview Schedule is a written list of questions, open ended or close ended, prepared for use by an interviewer in a person-to-person interaction (Kumar, 2009).

An interview schedule was developed to elicit information on personal information which consisted of address, mobile number, email address, type and size of family, occupation of the head and food preferences and participant's Internet use (Appendix I).

A questionnaire is a self-report data collection instrument which contains a set of questions that each research participant fills out as part of a research study (Johnson, 2012).

A questionnaire was specially designed which comprised of 16 multiple choice questions on nutrients, the basic function of nutrients in our body, nutrients essential during adolescence period, food sources and nutrient deficiencies (Appendix II).



RESEARCH DESIGN

FIGURE 1

D. ASSESSMENT OF SOCIO-ECONOMIC BACKGROUND, INTERNET USE AND NUTRITIONAL KNOWLEDGE

1. Assessment of Socio-Economic Background

Socio economic status requires several different modes of data, including income, occupation, land ownership and ownership of consumer items (Jensen, 2008).

Information on socio-economic background of the selected adolescent girls was collected by the interview schedule which contained questions about the type and size of the family, occupation of the head and total monthly income of the family, information on dietary pattern, food use frequency, and food preference of the adolescent girls (Plate I).

2. Assessment of Internet Use

The internet use of the adolescent girls was also assessed by administering the interview schedule which consisted of questions about the duration of time spent in browsing, purpose of browsing, access to online diet counseling and preference on internet learning.

3. Assessment of Nutritional Knowledge

The nutritional knowledge of the adolescent girls was assessed by administering the developed questionnaire in their respective classrooms after obtaining necessary permission from the subject teachers for a duration of 30 minutes. After imparting nutrition education, the same questionnaire was administered in the website to assess their nutritional knowledge.

E. DEVELOPMENT OF NUTRITION WEBSITE

1. Framing the content for the website

The foremost step in developing the website was framing the contents. Adolescent girls' dietary behaviours- basic knowledge on nutrition, and challenges influencing their dietary behaviours, and information on body mass

Plate I

index, nutritional problems due to their inappropriate food intake were considered for the content which aimed to inculcate nutritional knowledge among the adolescents. Information on the following topics was collected from various sources.

- Basic Food Groups
- Importance of Nutrition to Adolescents
- Growth and Development of Adolescents
- Nutrient requirements
- Nutritional Problems
- Special Situations
- Recommended Dietary Allowances, ICMR

Calculations

- Body Mass Index
- Nutrient Calculation

Text is the primary component of most web pages (Matthew, 2011). Each topic to be presented was chosen carefully, and the contents were made brief and use of lists was incorporated wherever possible.

Along with the textual contents, downloaded images were included to make the website interesting. A common logo was selected for all web pages in the website. The logo selected was “**Wise Adolescents – Nutritionally Secure!!!**”

2. Website Development Process

Web design and Programming involves conceptualizing, architecting, designing, organizing, implementing, maintaining, and improving websites for functionally effective and aesthetically attractive information delivery and exchange (Matthews et al., 2009).

The website was developed with the expertise and help of a web programmer and a web designer.

The overall Website development process is given below

i) **Site Architecture :**

The site architecture is influenced by the nature of the information being served and the means of delivery. Sites involve static pages with text, images, and online forms (Bates, 2008).

An appropriate architecture which will be attractive for adolescent girls was decided. The web architecture for navigation and select screens was determined by the web programmer; the screens and interactive tools were created by the web designer.

ii) **Content-only Site Framework:**

The introductory page of a website is known as Home page. A home page communicates the site's purpose, and shows all major options available on the website (Hester, 2009).

Home page and typical subpages were conceived. An easy access to home page from every page in the site was provided.

A navigation map which outlines the structure of the entire web project, showing all pages within the site and the connections from one page to others was outlined. A linear structure was used in the Nutrition website. This is the simplest way to organize a Website. In a linear structure, the user navigates sequentially moving from one page to the next (David, 2011).

iii) **Website Production:**

a) **Templates:** Templates are skeleton files used to make finished pages by inserting texts, graphics, and other contents at marked places in templates (Matthew, 2010). Templates were created for typical pages at all levels for the website.

b) **Client-side Programming:** Scripts are written for browsers and possibly other Web clients that will be delivered together with Web pages to the client side. Client-side programs can make webpages more interactive and responsive (David, 2008). The scripts included in the nutrition website were Style sheets and Java for the client-side programming.

c) **Server-side Programming:** The Web would be much less useful without the ability to request and process user input data (Lopuck, 2011). JQuery and JavaScript programs were used for form processing in *Questionnaire* of the Nutrition Website.

d) **Typography:** Typography is a very important element of web design. A website must have a good typographic foundation in order to communicate, explain, and even allow users to navigate its content (Shelly, et al., 2008). The fonts used in the Nutrition Website were **Tahoma** and **Verdana**. The font size used was 12.

e) **Images:** Using images can enhance almost any webpage if used appropriately. Without the visual impact of shape, colour, and contrast, web pages can be uninteresting graphically and will not motivate the visitor to investigate their contents (Shelly et al., 2010).

The images of Indian adolescent girls, food sources of nutrients and food pyramid were downloaded from www.google.com. These pictures were included in the web pages wherever necessary.

f) **Page Layout:** Page layout is the part of graphic design that deals with the arrangement and style treatment of content on a page (Mantaro, 2009).

g) **Colour:** Colour is used to add interest and viability to the website. Colour can be used in tables, as backgrounds, and with fonts (Joel, 2011).

Pink colour was used for the Nutrition Website, as pink is pleasing to girls in particular. The pink colour was used in the main background. The white colour was used as a background for the contents and black colour was used with fonts in the contents.

iv) **Reviewing and Testing Website:**

The Website was checked for any spelling mistakes and/or grammatical errors. The page layout was checked for its consistency. The programming written was tested for correct values.

After viewing the entire website before it was published, it was rated for its acceptance and satisfaction with the interface and navigation, tone and colour, and content of the website and the spelling mistakes were corrected.

3. Publishing the Website

Publishing a Website is the process of making it available to the users. It involves actual uploading of the website to a server.

i) **Domain Name:**

A domain name is a unique name for the web site. Websites are accessed by an IP address or a domain name. Domain names must be registered. When domain names are registered, information about the web site, including the IP address, is stored on a Domain Name System (DNS) server. A DNS server is responsible for informing all other computers on the Internet about the domain name and the web site address. (Flieshman, 2009)

A domain name should be easy to pronounce, spell and remember. It should also relate to the website content (Jacqueline, 2010). The domain name that was registered for the nutrition website was **www.nutrition-ijkl.in**.

ii) **Uploading the Website:**

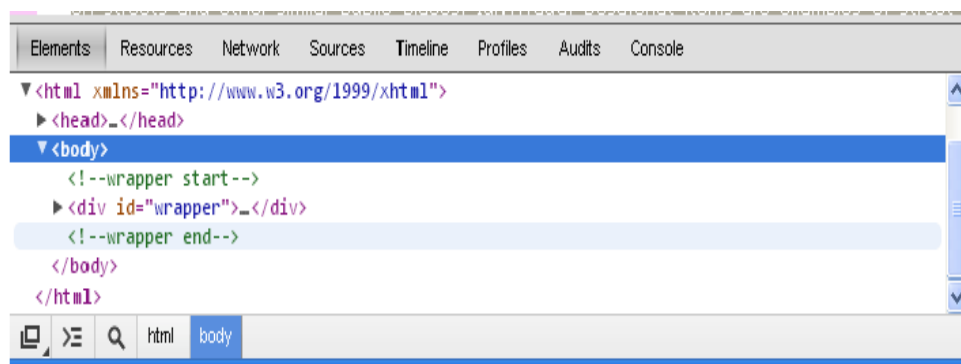
Uploading is the process of transmitting from the computer all the files that comprises the Website to the selected server (Shelly et al., 2009). File Transfer Protocol (FTP) program was used to upload files containing each individual web page to the server.

4. Programs and Tools Used

i) HTML:

HTML stands for Hypertext Markup Language. It is an authoring language used to create documents on the World Wide Web. HTML uses a set of special instructions called tags or markup to define the structure and layout of the Web document and specify how the page is displayed in a browser (Shelly et al., 2008). The software application used to create HTML for the nutrition website was Dreamweaver (Figure 2).

Dreamweaver is a web design and development tool. It provides an integrated text editor with a graphical interface that allows the user to view both the code and the document as it is being created (Osborn, 2012).



HTML page

Figure 2

ii) PHP:

PHP stands for PHP: Hypertext Preprocessor. It is a server-side scripting language designed for web development, which is also used as general-purpose programming language. PHP allows developers to embed structured code inside HTML tags. PHP scripts could parse data submitted by HTML forms; communicate with databases, and makes complex calculations (Atkinson et al., 2008).

Mathematical calculations for Body Mass Index and Nutrient Calculations in the Nutrition website were done using corePHP. *Nutrient*

Calculation – Enter Your Whole Day Menu allows the use to select foods consumed over the course of a day and get feedback on caloric, protein and fat intake, compared with ICMR Recommended Dietary Allowance. *Calculate Your BMI* allows user to view their body mass index along with their BMI grade, when their height and weight is entered.

iii) JavaScript:

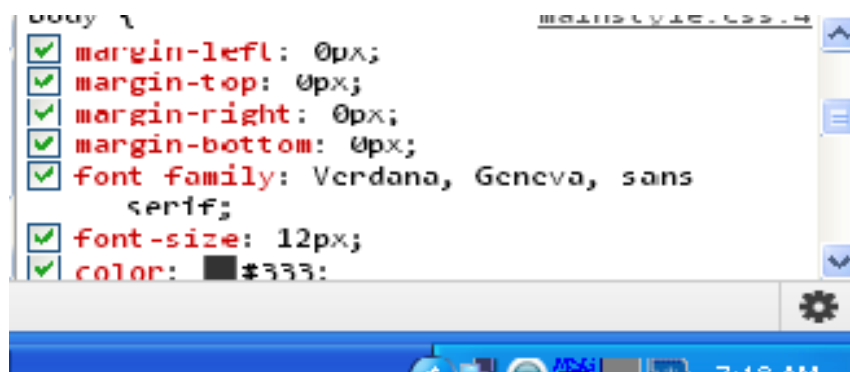
JavaScript is a programming language that enhances HTML with animation, interactivity and dynamic visual effects. JQuery is a JavaScript library intended to make JavaScript programming easier to use (David, 2012).

JavaScript programs were used to check the correctness of the data input in the *Questionnaire* and *Nutrient Calculation- Enter Your Whole Day Menu* and *Calculate Your BMI* forms on the client side.

iv) Cascading Style Sheets:

The Cascading Style Sheets (CSS) provides the designer the power to control design of the website (West et al., 2009).

From precise margins to pixel-perfect spacing to fonts and typefaces, CSS was used for the layout method in the nutrition website (Figure 3).



Cascading Style Sheet

Figure 3

v) **Photoshop:**

Adobe Photoshop is an image-editing program. Photoshop's primary functions are to merge and edit color images, to retouch proofs, and to create composite artwork for print or on the web. It enhances the ability to process images for the web (Peter, 2011). Photoshop was used to make the background of the image transparent to merge in the webpage of the nutrition website. Pages of the developed website is given as Appendix III.

F. IMPLEMENTATION OF NUTRITION EDUCATION THROUGH THE DEVELOPED NUTRITION WEBSITE

Nutrition education has been defined as "Any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviours conducive to health and well being" (Kathleen et al., 2012).

The selected adolescent girls were instructed to visit the nutrition website **www.nutrition-ijkl.in** at their homes or at the Computer Laboratory and Computer Centre of the University. They were instructed to type the web address in any browsers they use and open the home page of the website. They were asked to go through the contents on each web page, and calculate their Body Mass Index and their Nutrient Intake (Plate II).

G. EVALUATION OF THE IMPACT OF NUTRITION EDUCATION

Evaluating educational technology involves determining if the technology is appropriate and enhances the learning process (Gary et al., 2008).

The selected adolescent girls were asked to answer the questions posted in the questionnaire and opinionnaire in the website. Nutritional knowledge attained through the website was evaluated by determining the mean changes in the total knowledge scores before and after accessing nutrition website.

Plate II

H.ANALYSIS OF DATA

The data obtained through the developed tools was consolidated, tabulated, interpreted and statistically analyzed. t-test was performed to determine differences in the nutrition knowledge levels between the non-nutrition students and nutrition students at baseline as well as after imparting nutrition education through nutrition website. In order to determine the significance of difference in the increment of knowledge due to the nutrition education intervention, paired t-test was performed.

IV RESULTS AND DISCUSSION

The results of the present study titled “**Developing an Interactive Nutrition Website and Evaluating its effectiveness among Adolescent Girls**” are presented and discussed under the following headings

- A. General information of selected adolescent girls
- B. Health status of selected adolescent girls
- C. Dietary pattern of selected adolescent girls
- D. Internet usage of selected adolescent girls
- E. Impact of nutrition education on selected adolescent girls
- F. Evaluation of the nutrition website

A. GENERAL INFORMATION OF SELECTED ADOLESCENT GIRLS

General information of selected adolescent girls is discussed under the following headings.

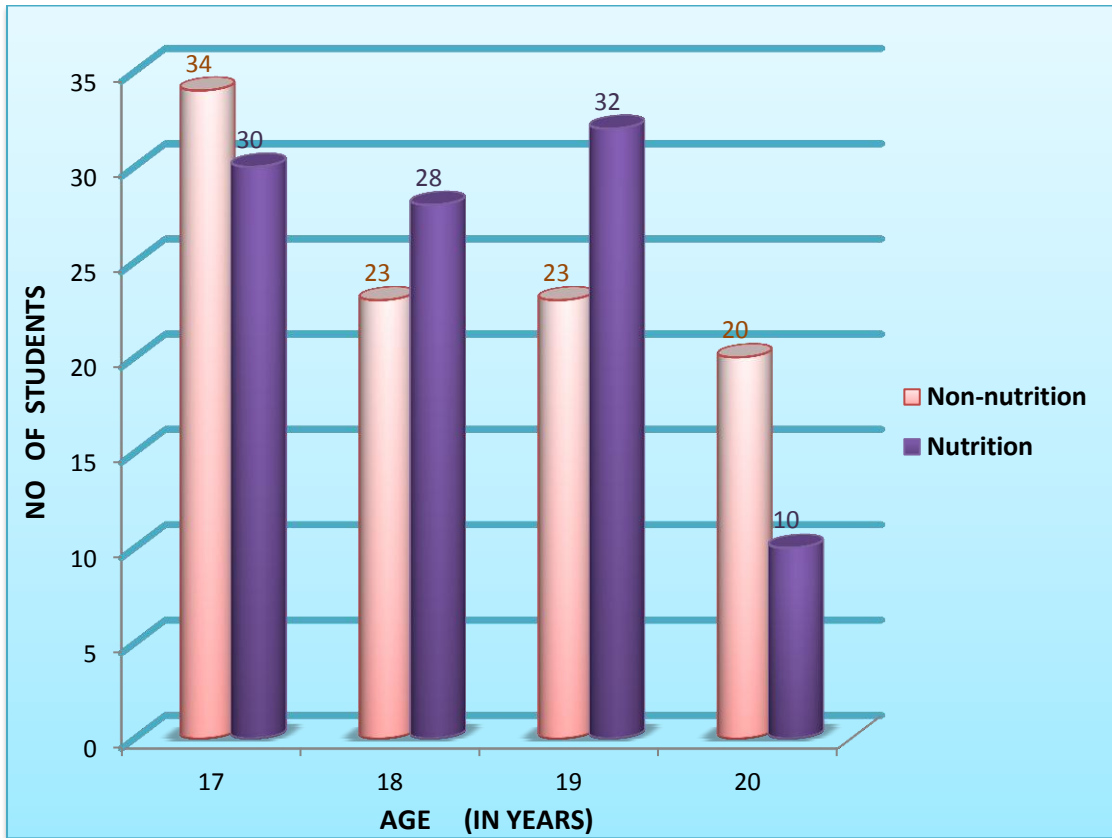
1. Age of selected adolescent girls

The age of selected adolescent girls are presented in Table I and Figure 4.

TABLE I

AGE OF SELECTED ADOLESCENT GIRLS

Age (in years)	Non-Nutrition (N=100)	Nutrition (N=100)
17	34	30
18	23	28
19	23	32
20	20	10



AGE OF SELECTED ADOLESCENT GIRLS

FIGURE 4

Among the selected group of non-Nutrition students, 34 students belonged to the age group of 17 years, followed by 23 students in both the age group of 18 and 19 years, followed by 20 students in the age group of 20 years. Among the Nutrition students, 32 students belonged to the age group of 19 years, 30 students belonged to the age group of 17 years, 28 students belonged to the age group of 18 years and only 10 students of them were 20 years old.

2. Socio-economic background of the selected adolescent girls

Details regarding the socio-economic background of the selected adolescent girls were elicited in terms of their type of family, total monthly income of the family, occupation of the head of the family using a questionnaire and results obtained were tabulated as follows. Table II shows the socio-economic background of the selected adolescent girls.

TABLE II
SOCIO-ECONOMIC BACKGROUND OF SELECTED
ADOLESCENT GIRLS

Details	Non-Nutrition (N=100)	Nutrition (N=100)
Type of family		
Nuclear	80	89
Joint	20	11
Size of Family (Members)		
3	11	16
4	58	54
5	23	18
6	8	12
Occupation of the head of the family		
Agriculturists	22	12
Business	19	25
Executives	9	15
Govt. Employees	8	18
Labourers	34	30
Total monthly income*		
<Rs.3300	1	5
Rs.3301-7300	24	28
RS.7301-14500	34	34
>Rs.14501	41	33

*Affordable Housing for Urban Poor, National Resource Centre, School of Planning & Architecture, Ministry of Housing & Urban Poverty Alleviation, Govt. of India, 2009.

Eighty non-nutrition students and 89 nutrition students belonged to nuclear families and 20 students and 11 students of non-nutrition and nutrition groups belonged to joint families respectively.

With regard to the family size among non- nutrition group, 11 students belonged to families consisting of three members and 16 nutrition students belonged to families consisting of three members. The number of non-nutrition students who belonged to families consisting of four members was 58 and nutrition students were 54 in number, followed by families consisting of five members were 23 non-nutrition students and 18 nutrition students. The number of non-nutrition students who belonged to families consisting of six members was 8 and non-nutrition students were 12 in number.

Among the surveyed group, it was found that head of the families of 22 non-nutrition students and head of the families of 12 nutrition students were agriculturists, whereas head of the families of 19 non-nutrition students and head of the families of 25 nutrition students were businessmen, head of the families of 9 non-nutrition students and head of the families of 15 nutrition students were executives, head of the families of 8 non-nutrition students and head of the families of 18 nutrition students were Government Employees and head of the families of 34 non-nutrition students and head of the families of 30 nutrition students were labourers.

Forty one families of non-nutrition students and 33 families of nutrition students had a monthly income of more than Rs.14,500, whereas 34 families of both non-nutrition and nutrition groups had a monthly income of more than Rs.7300 but less than Rs.14500, 24 and 28 families of non-nutrition and nutrition students had more than Rs.3300, but less than Rs.7300 and one family of non-nutrition and five families of non-nutrition group had a monthly income of more than Rs.3000 but less than Rs.7300.

B. HEALTH STATUS OF SELECTED ADOLESCENT GIRLS

Health information of selected adolescent girls is discussed under the following headings.

1. Methods followed to stay healthy

Details regarding the methods followed by the selected adolescent girls to stay healthy were collected and the results obtained were tabulated in Table III.

TABLE III
METHODS FOLLOWED TO STAY HEALTHY

Methods	Non-Nutrition (N=100)*	Nutrition (N=100)*
Yoga	12	16
Meditation	9	15
Physical Activity	12	32
Diet Modification	8	30
None	63	17

*Multiple response

Among non-nutrition group, 12 students did physical activity and yoga to stay healthy, followed by 9 students who did meditation, and only 8 students followed diet modification to stay healthy.

Among nutrition group, 32 students did physical activity to stay healthy, followed by 30 students who followed diet modification, followed by 16 students who did yoga and 15 students who did meditation to stay healthy.

Sixty three non-nutrition students and 17 nutrition students did not indulge in any activities to stay healthy.

2. Adolescent girls attending diet counseling

Details regarding whether the selected adolescent girls attended diet counseling was collected and the results were tabulated as follows in Table IV.

TABLE IV
ADOLESCENT GIRLS ATTENDING DIET COUNSELING

Details	Non-Nutrition (N=100)	Nutrition (N=100)
Attending Diet counseling	6	14
Not attending Diet counseling	94	86

Among the surveyed group, it was found that 94 non-nutrition students and 86 nutrition students had not attended diet counseling, while six non-nutrition students and 11 nutrition students had attended diet counseling.

3. Sources of Nutrition information for the selected adolescent girls

According to Buhia *et al.* (2009), adolescents recognize the importance of nutrition information. Most of the adolescents were primarily learning about, receiving information from, and generating nutrition information needs from teachers and assigned textbooks. Adolescents use parents, teachers, friends, books, magazines, internet, television, and nutrition labels as sources of information about food and beverages. The sources of Nutrition information of the selected adolescent girls are presented in Table V.

TABLE V
SOURCES OF NUTRITION INFORMATION FOR
THE SELECTED ADOLESCENT GIRLS

Details	Non-Nutrition (N=100)*	Nutrition (N=100)*
School/ College	66	99
Peers / Friends	53	63
Parents	62	58
Radio/TV/Magazines	63	62
Internet	63	71

*Multiple response

Sixty six non-nutrition students and 99 nutrition students obtained their nutrition information from school or college. Fifty three non-nutrition students and 63 nutrition students obtained their nutrition information from their peers or friends. Sixty two non-nutrition students and 58 nutrition students obtained their nutrition information from their parents. Sixty three non-nutrition students and 62 nutrition students obtained their nutrition information from radio or television or magazines, while 63 non-nutrition students and 71 nutrition students obtained their nutrition information from the internet.

C. DIETARY PATTERN OF SELECTED ADOLESCENT GIRLS

Dietary pattern established during adolescent period shapes the diet in later life. Compared with young children, adolescents have more access to food outside home, experiment more with food choices, deviate more from a three meals a day pattern and are more likely to eat snacks.

1. Type of diet consumed

In a study among 10 to 19 years adolescent girls in Varanasi district, India, Choudhary *et al.*, (2010) noted that 29 per cent, 56 per cent and 15 per cent subjects were vegetarian, non-vegetarian and ova-vegetarian, respectively. The details regarding the type of diet consumed by selected adolescent girls are presented in Table VI.

TABLE VI
TYPE OF DIET CONSUMED AMONG SELECTED
ADOLESCENT GIRLS

Type of diet consumed	Non-Nutrition (N=100)	Nutrition (N=100)
Vegetarian	18	6
Non-vegetarian	79	83
Ova-vegetarian	3	11

The above table revealed that 18 non-nutrition students and 6 nutrition students consumed vegetarian diet, 79 non-nutrition students and 83 nutrition students consumed non-vegetarian diet, followed by 3 non-nutrition and eleven nutrition students who consumed ova-vegetarian diet.

2. Meal Pattern

In a cross-sectional study in North India among 11 to 21 years adolescents numbering 209, Malhotra *et al.*, (2009) observed that most of the subjects followed a two meal pattern. Details pertaining to the number of meals per day consumed by the selected adolescent girls are given in Table VII.

TABLE VII
MEAL PATTERN OF SELECTED ADOLESCENT GIRLS

Number of meals	Non-Nutrition (N=100)	Nutrition (N=100)
2	14	7
3	80	74
4	6	19

Eighty non-nutrition students and 74 nutrition students followed a three meal pattern and 14 non-nutrition students and 7 nutrition students followed a two meal pattern, and the remaining 6 non-nutrition students and 19 nutrition students followed four meal patterns per day.

3. Details pertaining to skipping meals by the selected adolescent girls

The dietary pattern of adolescents was often influenced by breakfast skipping, fast food and snack consumption and weight management issues.

a. Meal skipping pattern

According to Zhu *et al.* (2011), more university students had the habits of skipping breakfast. Details about meal skipping pattern of selected adolescent girls were given in Table VIII.

TABLE VIII
MEAL SKIPPING PATTERN AMONG SELECTED
ADOLESCENT GIRLS

Type of meal skipped	Non-Nutrition (N=100)	Nutrition (N=100)
Nil	52	42
Breakfast	43	44
Lunch	2	11
Dinner	3	3

It was observed from the above table, 43 non-nutrition students and 44 nutrition students skipped breakfast. Among the selected group, two non-nutrition students and eleven nutrition students skipped their lunch respectively, which is surprising and 3 students of both non-nutrition and nutrition group skipped their dinner. Fifty two non-nutrition students and forty two nutrition students did not skip their meals.

b. Reasons for skipping meals

Reasons for skipping the meals as given by the selected adolescent girls are given in Table IX.

TABLE IX
REASONS FOR SKIPPING MEALS BY SELECTED
ADOLESCENT GIRLS

Reasons	Non-Nutrition (N=48)		Nutrition (N=58)	
	No	%	No	%
Time constraints	35	73	40	69
Fasting	13	27	18	31

Among non-nutrition students, 73 per cent expressed time constraints as the major reasons for missing their meals. Among the nutrition students, 69 per cent expressed time constraints as the major reason for missing their meals. Twenty seven per cent of non-nutrition and thirty one per cent of nutrition students skipped their meals due to fasting.

4. Frequency of skipping the meal

In a study among adolescents of 12 to 18 years in the schools of Delhi, it was observed that out of 1814 participants, 30 per cent consumed breakfast less than daily, out of which 22 per cent skipped breakfast once/twice in a week and 8 per cent of adolescents skipped breakfast daily (Monika et al., 2012). Details regarding the frequency of skipping the meal are given in Table X.

TABLE X
FREQUENCY OF SKIPPING THE MEAL BY SELECTED
ADOLESCENT GIRLS

Frequency of skipping meal	Non-nutrition (N=48)		Nutrition (N=58)	
	No	%	No	%
Daily	9	19	8	14
Once/ twice a week	27	56	26	45
Occasionally	12	25	24	41

It is revealed from the table, 19 per cent of non-nutrition students and 14 per cent of nutrition students skipped their meals daily. Fifty six per cent of non-nutrition students and 45 per cent of nutrition students skipped their meals once/twice a week, whereas 25 per cent of non-nutrition students and 41 per cent of nutrition students skipped their meals occasionally. It is surprising to know that almost an equal number of non-nutrition and nutrition students skipped their breakfast.

5. Compensation for skipped meals

Details about the food items that are consumed instead of the meals skipped are given in the Table XI.

TABLE XI
COMPENSATION FOR SKIPPED MEALS BY SELECTED
ADOLESCENT GIRLS

Name of the food items	Non-nutrition (N=48)		Nutrition (N=58)	
	No	%	No	%
Fruit juices	14	29	18	31
Snacks	28	58	12	21
Whole fruits	5	11	15	26
Nil	1	2	13	22

It is revealed from the table that 29 per cent of non-nutrition students and 31 per cent of nutrition students consumed fruit juices to compensate their skipped meals, 58 per cent and 21 per cent of non-nutrition and nutrition students preferred snacks to compensate the skipped meals, 11 per cent and 26 per cent of non-nutrition and nutrition students preferred whole fruits to compensate their skipped meals respectively. The remaining two per cent of non-nutrition and twenty two per cent of nutrition students never compensated for their skipped meals.

6. Food frequency among selected adolescent girls

Details regarding food frequency among adolescent girls are presented in Table XII.

TABLE XII
FOOD FREQUENCY AMONG SELECTED
ADOLESCENT GIRLS

Food groups	Non-Nutrition (N=100)			Nutrition (N=100)		
	Daily	Weekly	Rarely	Daily	Weekly	Rarely
Cereals	100	-	-	100	-	-
Pulses	72	28	-	82	18	-
Green leafy vegetables	17	53	30	17	54	29
Other vegetables	53	38	9	51	40	9
Roots and Tubers	24	42	34	27	54	9
Fruits	41	49	10	39	43	18
Milk and milk products	77	17	6	89	2	9
Meat	1	52	26	4	49	30
Fish and sea foods	5	51	23	2	52	29
Eggs	23	15	44	29	24	41
Fats and oils	100	-	-	100	-	-
Oilseeds and nuts	-	42	58	-	56	-
Sugar	100	-	-	100	-	-
Spices and condiments	100	-	-	100	-	-
Hotel/ canteen foods	12	40	48	6	35	59
Fast foods	10	38	52	55	40	55
Sweets	35	40	25	15	63	22
Snacks	83	17	-	80	20	-
Soft drinks	23	37	40	8	32	60

From the table, it is observed that all the students of both non-nutrition and nutrition group consumed cereals, fats and oils, spices and condiments and sugar daily. Seventy two non-nutrition students and 82 nutrition students took pulses daily, while 28 non-nutrition and 18 nutrition students consumed pulses weekly.

Seventeen students of both non-nutrition and nutrition group ate green leafy vegetables daily. Fifty three non-nutrition students and 54 nutrition students ate green leafy vegetables weekly, while 30 non-nutrition students and 29 nutrition students ate green leafy vegetables rarely. Fifty three non-nutrition and fifty one nutrition students consumed other vegetables daily, while 38 non-nutrition students and 40 nutrition students consumed other vegetables weekly and the remaining 9 students of both non-nutrition and nutrition group consumed other vegetables rarely. Twenty four non-nutrition students and 27 nutrition students consumed roots and tubers daily, while 42 non-nutrition students and 54 nutrition students consumed roots and tubers weekly, and the remaining 34 non-nutrition students and nine nutrition students consumed roots and tubers rarely.

Seventy seven non-nutrition students and 89 nutrition students consumed milk and milk products daily, while 17 non-nutrition students and two nutrition students consumed milk and milk products weekly, and the remaining six non-nutrition and nine nutrition students consumed milk and milk products rarely.

Among seventy nine per cent of non-nutrition students consuming non-vegetarian foods, one per cent and six per cent of students consumed meat and fish and other sea foods daily respectively, while 66 per cent and 65 per cent of students consumed meat and fish and other sea foods weekly respectively and 33 per cent and 29 per cent of students consumed meat and fish and other sea foods rarely respectively.

Among eighty three per cent of nutrition students consuming non-vegetarian foods, five percent and two per cent of students consumed meat and

fish and other sea foods daily respectively, while 60 per cent and 63 per cent of students consumed meat and fish and other sea foods weekly respectively, and the remaining 36 per cent and 35 per cent of students consumed meat and fish and other sea foods rarely respectively.

Among eighty two per cent of non-nutrition students who consumed non-vegetarian foods and only egg, 28 per cent of students consumed egg daily, while 18 per cent of students ate egg weekly and 54 per cent of students ate egg rarely.

Among ninety four per cent of nutrition students who consumed non-vegetarian foods and only egg, 31 per cent of students consumed egg daily, while 25 per cent of students consumed egg weekly and the remaining 44 per cent of students consumed egg rarely.

Forty two non-nutrition students and 56 nutrition students ate oilseeds and nuts weekly, while the remaining 58 non-nutrition students and 44 nutrition students ate oilseeds and nuts rarely.

Twelve non-nutrition students and six nutrition students consumed hotel/canteen foods daily, while 40 non-nutrition students and 35 nutrition students consumed hotel/canteen foods weekly, and the remaining 48 non-nutrition students and 59 nutrition students consumed hotel/canteen foods rarely.

Ten non-nutrition students and five nutrition students consumed fast foods daily, while 38 non-nutrition students and 40 nutrition students consumed fast foods weekly, and the remaining 52 non-nutrition students and 55 nutrition students consumed fast foods rarely.

Thirty five non-nutrition students and 15 nutrition students consumed sweets daily, while 40 non-nutrition students and 63 nutrition students consumed sweets weekly, and the remaining 25 non-nutrition students and 22 nutrition students took sweets rarely.

Eighty three students and 23 students of non-nutrition group consumed snacks and soft drinks daily respectively, while 17 students and 37 students of non-nutrition group consumed snacks and soft drinks weekly respectively, and the remaining 40 non-nutrition students consumed soft drinks rarely. Eighty students and 8 students of nutrition group consumed snacks and soft drinks daily respectively, while 20 students and 32 students of nutrition group consumed snacks and soft drinks weekly respectively, and the remaining 60 nutrition students consumed soft drinks rarely.

7. Food preference among selected adolescent girls

In a cross-sectional study among 12 to 18 adolescent schools girls in Baghdad, numbering 303, a considerable proportion 125 (41.2 per cent) of girls, reported disliking of milk and thus rarely drinking it (Majeed, et al., 2009). Details regarding food preference among selected adolescent girls are presented in Table XIII.

TABLE XIII
FOOD PREFERENCE AMONG SELECTED ADOLESCENT GIRLS

Food groups	Non-Nutrition (N=100)		Nutrition (N=100)	
	Like	Dislike	Like	Dislike
Cereals	83	17	89	11
Pulses	67	33	91	9
Green leafy vegetables	75	25	86	14
Other vegetables	78	22	82	18
Roots and tubers	67	33	83	17
Fruits	90	10	92	8
Milk and milk products	84	16	91	9
Meat	52	27	63	24
Fish and sea foods	50	29	62	25
Eggs	56	26	83	12
Oilseeds and nuts	65	35	71	29
Sugar	88	12	90	10
Hotel/Canteen foods	77	23	69	31
Fast foods	73	27	74	26
Sweets	87	13	87	13
Snacks	83	17	75	25
Soft drinks	83	17	72	28

It is revealed from the study that 90 non-nutrition students and 92 nutrition students liked fruits, 83 non-nutrition students liked snacks and soft drinks and 75 students and 72 students of nutrition group liked snacks and soft drinks respectively. Eighty eight students and 87 students of non-nutrition group liked sugar and sweets respectively. Seventy seven students and 73

students of non-nutrition group liked hotel/ canteen foods and fast foods respectively, while 69 students and 74 students of nutrition group liked hotel/canteen foods. Eighty four non-nutrition students and 91 nutrition students liked milk and milk products.

Seventy five students and 78 students of non-nutrition group liked green leafy vegetables and other vegetables respectively. Eighty six students and 82 students of nutrition group liked green leafy vegetables and other vegetables respectively.

Twenty five non-nutrition students and 14 nutrition students disliked green leafy vegetables whereas only 16 non-nutrition students and 9 nutrition students disliked milk and milk products. Twenty two non-nutrition students and eighteen nutrition students disliked other vegetables. Thirty four percent of non-nutrition students and 24 percent of nutrition students disliked meat whereas 37 percent of non-nutrition students and 25 percent of nutrition students disliked fish and other sea foods. Twenty three non-nutrition students and 31 nutrition students disliked hotel/ canteen foods.

D.INTERNET USAGE OF SELECTED ADOLESCENT GIRLS

Internet usage of selected adolescent girls is discussed under the following headings.

1. Accessing internet by the selected adolescent girls

The Pew Internet Survey (2008) reported that 83 to 87 per cent of adolescents use the internet. Details regarding accessing of internet by the selected adolescent girls are presented in Table XIV.

TABLE XIV
ACCESSING INTERNET BY THE SELECTED ADOLESCENT
GIRLS

Details	Non-Nutrition (N=100)	Nutrition (N=100)
Accessing internet	90	97
Not accessing internet	10	3

Among the non-nutrition group, 90 students browsed the internet, and only ten students did not browse the internet. Among the nutrition group, 97 students browsed the internet and only three students did not browse the internet.

2. Time duration spent in browsing daily

According to Johnson (2007), only two of the 405 college students surveyed in college students in Alberta never accessed internet. Approximately five per cent of students indicated infrequent use of the Internet. Almost 95 per cent of respondents indicated that they accessed internet at least a few times a week. Details regarding the time spent by the selected adolescent girls in browsing daily are presented as follows in Table XV.

TABLE XV**TIME DURATION SPENT IN BROWSING DAILY**

Time (in hours)	Non-Nutrition (N=90)		Nutrition (N=97)	
	No	%	No	%
<1	40	44	53	55
1-2	33	37	39	40
>2	17	19	5	5

Forty four per cent of non-nutrition students and 55 per cent of nutrition students spend less than one hour in browsing daily, while 37 per cent of non-nutrition students and 40 per cent of nutrition students spend more than one hour but less than two hours in browsing daily, while the remaining 19 per cent of non-nutrition students and 5 per cent of nutrition students spend more than two hours in browsing daily.

3. Purpose of using internet

Details regarding the purpose of using internet by the selected adolescent girls are presented in Table XVI.

TABLE XVI
PURPOSE OF USING INTERNET

Details	Non-nutrition (N=90)*		Nutrition (N=97)*	
	No.	%	No.	%
Educational tool	86	95	84	87
Recreational tool	0	0	11	11
Social networking	43	48	24	25
Health information	0	0	22	23

* Multiple response

From the above table, it is revealed that 95 per cent of non-nutrition students and 87 per cent of nutrition students used internet as educational tool. Eleven per cent of nutrition students used internet for recreational purpose. Forty eight per cent of non-nutrition students and 25 per cent of nutrition students used internet for social networking, while only 23 per cent of nutrition students used internet for health information, and non-nutrition students did not use internet for getting health information.

4. Accessing nutrition website by the selected adolescent girls

Use of the Internet to retrieve health information is increasingly common. According to Escoffery *et al.*, (2009), in a study among 743 undergraduate students at 2 academic institutions in USA, it was observed that 74 per cent of the students reported having ever received health information online. Purcell *et al.* (2010) reported that among the 93 per cent of all U.S. teens (age 12 to 17) online, 31 percent have searched the internet for information on general health, dieting, or physical fitness. Details regarding accessing nutrition website by the selected adolescent girls is presented in Table XVII.

TABLE XVII
ACCESSING NUTRITION WEBSITE BY THE SELECTED
ADOLESCENT GIRLS

Details	Non-nutrition (N=90)		Nutrition (N=97)	
	No	%	No	%
Accessing Nutrition website	15	17	60	62
Not accessing Nutrition Website	75	83	37	38

Among non-nutrition students, 83 per cent of students did not access nutrition websites, while only 17 per cent of students visited nutrition websites.

Sixty two per cent of nutrition students accessed nutrition websites, while 38 per cent of students did not visit nutrition websites.

5. Accessing online diet counseling by the selected adolescent girls

Details regarding accessing online diet counseling by the selected adolescent girls are presented in Table XVIII.

TABLE XVIII
ACCESSING ONLINE DIET COUNSELLING BY
SELECTED ADOLESCENT GIRLS

Details	Non-nutrition (N=90)		Nutrition (N=97)	
	No	%	No	%
Accessing	4	4	9	9
Not accessing	86	96	88	91

Ninety six per cent of non-nutrition students and ninety one per cent of nutrition students had not accessed online diet counseling, while four per cent of non-nutrition students and nine per cent of nutrition students had accessed online diet counseling.

6. Preference for nutrition learning

Details regarding the preference of selected adolescent girls for nutrition learning are presented in Table XIX

TABLE XIX
PREFERENCE FOR NUTRITION LEARNING

Details	Non-Nutrition (N=100)	Nutrition (N=100)
Lecture on Nutrition	32	36
Internet Learning	68	64

From the above table, it is revealed that 68 non-nutrition students and 64 nutrition students preferred internet learning for nutrition learning, while only 32 non-nutrition students and 36 nutrition students preferred lecture on nutrition.

E. IMPACT OF NUTRITION EDUCATION ON SELECTED ADOLESCENT GIRLS

a. Differences in the nutritional knowledge levels

In a study conducted at China to examine the rational knowledge of University students, LiuYa *et al.* (2009), observed that the students had lack of nutrition knowledge. According to Choudhary *et al.*, (2010), in a study among 10 to 19 years adolescent girls in Varanasi district, India, the nutrition related knowledge of adolescent girls was not satisfactory. Majority of the subjects were not aware about their nutritional requirements.

Details regarding differences in the nutritional knowledge levels between the selected non-nutrition and nutrition adolescent girls are presented in Table XX and Figure 5.

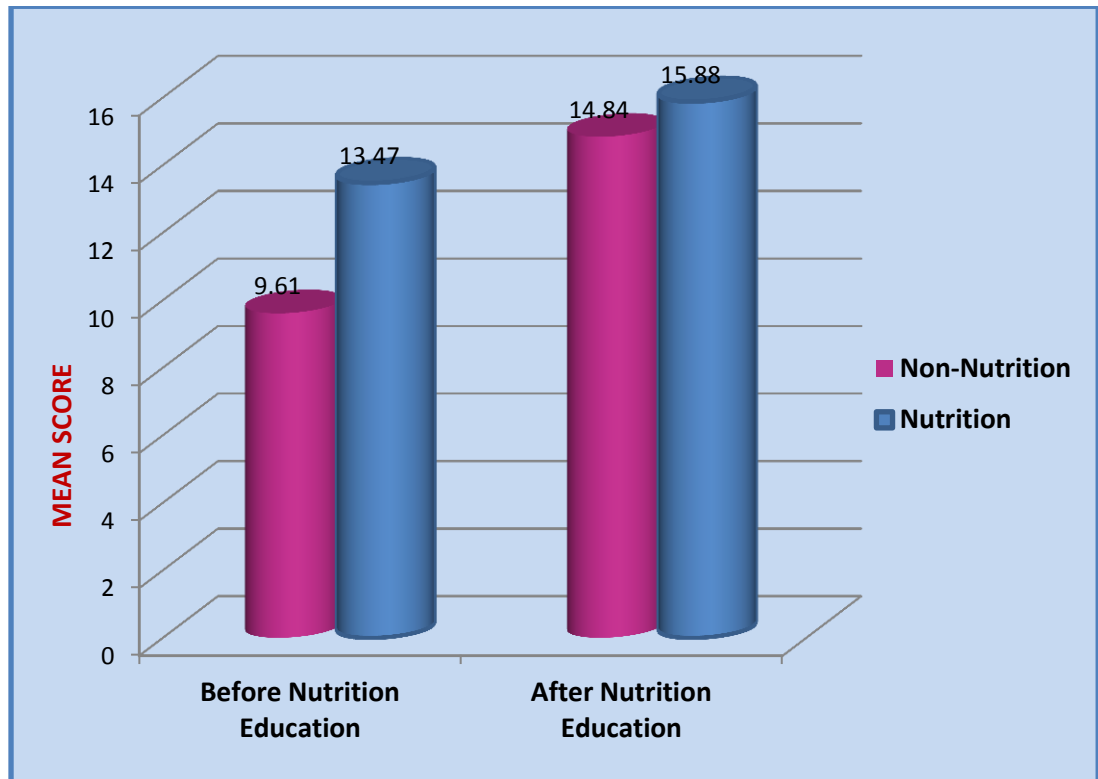
TABLE XX
DIFFERENCES IN THE NUTRITIONAL KNOWLEDGE LEVELS
BETWEEN THE SELECTED NON-NUTRITION AND NUTRITION
ADOLESCENT GIRLS

Total Score=16

Details	Mean Scores		t-value
	Non-Nutrition (N=100)	Nutrition (N=100)	
Before Nutrition Education	9.61+3.96	13.47+2.99	7.87*
After Nutrition Education	14.84+1.51	15.88+0.35	6.9*

*significant at 1% level

The results revealed that there is a significant difference at one per cent level in the initial nutritional knowledge of the nutrition students when compared with non-nutrition both before imparting nutrition education and after imparting nutrition education through nutrition website. The nutrition students showed higher scores than the non-nutrition students.



**DIFFERENCES IN THE NUTRITIONAL KNOWLEDGE SCORES
BETWEEN THE SELECTED NON-NUTRITION AND NUTRITION
ADOLESCENT GIRLS**

FIGURE 5

b. Changes in the nutritional knowledge on selected adolescent girls after imparting nutrition education

According to Kreisel (2009), a significant increase in pupils' nutritional knowledge was found in the study groups after the computer-based nutrition education intervention, in a study among college adolescents in Vienna, Austria.

Kim *et al.* (2006) investigated the effects of nutrition education website 'ifood' on nutrition knowledge, dietary attitudes and dietary behaviours of 262 children of 5th and 6th classes in Korea. Children navigated the website by themselves in order to gain knowledge. Pre-test and post-test were given to the children. The results of the study demonstrated a significant increase in nutrition knowledge scores. Improvements in some dietary behaviour and attitudes was also indicated.

The evaluation study of two different educational tools on nutrition knowledge in India found traditional method more effective in increasing the nutrition knowledge of respondents than CD-ROM. Rughunatha *et al.* (2007), further more reported that the attention of respondents was very high during the traditional method as compared to CD-ROM intervention and regarded it a contributing factor of low increment of nutrition knowledge in CD-ROM intervention.

Changes in the nutritional knowledge among the selected adolescent girls are presented in Table XXI and Figure 6.

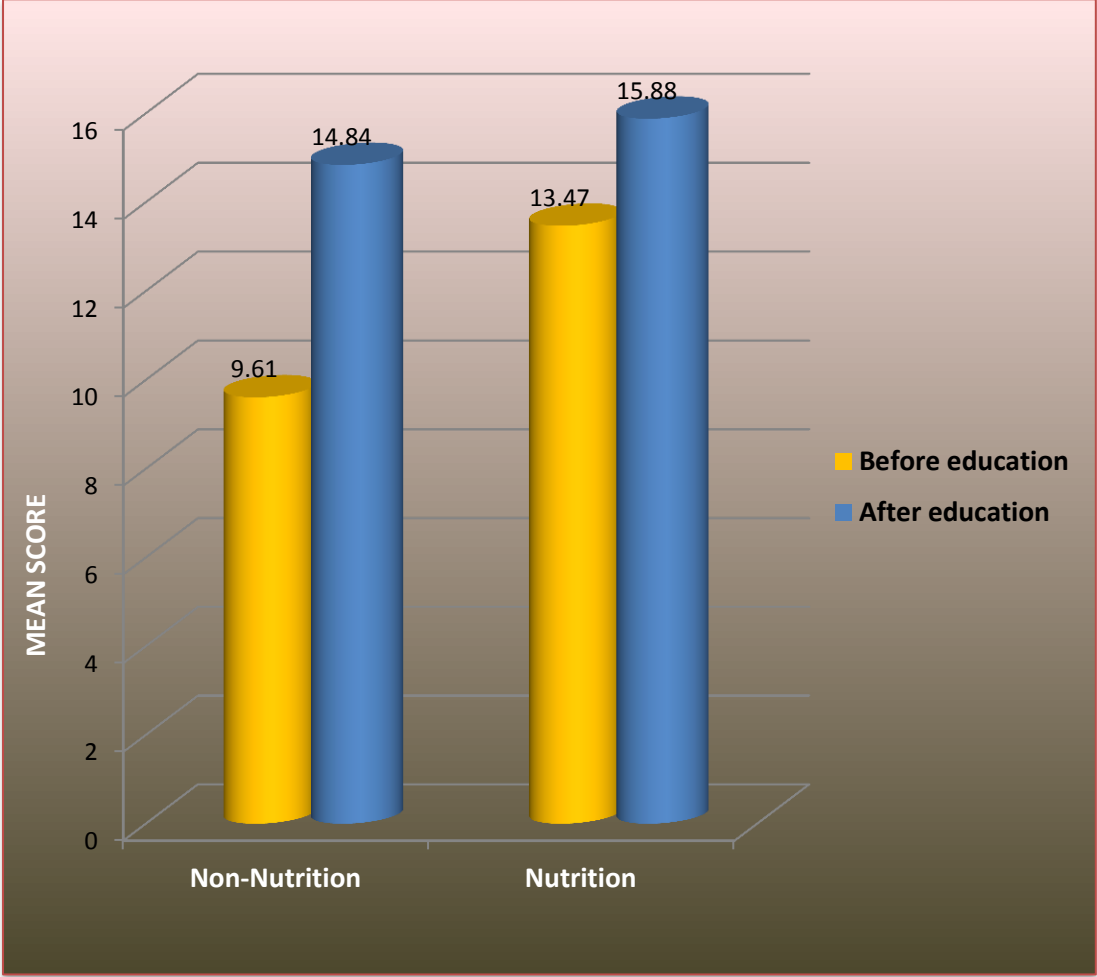
TABLE XXI
CHANGES IN THE NUTRITIONAL KNOWLEDGE

N=100

Groups	Mean scores			t-value
	Before accessing nutrisite	After accessing nutrisite	Differences	
Non-Nutrition	9.61+3.96	14.84+1.51	5.23+2.91	18.00*
Nutrition	13.47+2.99	15.88+0.35	2.41+2.78	8.62*

*significant at 1 % level

After imparting nutrition education through nutrition website, it was observed that nutritional knowledge of both non-nutrition and nutrition student showed a positive improvement. The mean scores before education among non-nutrition students and nutrition students were 9.6 and 13.47 respectively, and after imparting education through nutrition website, it had increased to 14.84 and 15.88 for non-nutrition and nutrition students respectively. The knowledge gained in terms of scores by the non-nutrition and nutrition students showed significant improvement at one per cent level after the students had gained nutritional knowledge, on viewing the nutrition website.



CHANGES IN THE NUTRITIONAL KNOWLEDGE

FIGURE 6

F. EVALUATION OF THE NUTRITION WEBSITE

An online opinionnaire form was administered to the selected adolescent girls in the nutrition website with a view to evaluate the adequacy and usefulness of the website. Their responses are presented below.

TABLE XXII
INFORMATION OBTAINED FROM THE OPINIONNAIRE

Details	Non-Nutrition (N=100)				Nutrition (N=100)			
	SA	A	UD	D	SA	A	UD	D
The website is interesting	77	23	-	-	81	19		
The website is easy to understand	80	20	-	-	83	17	-	-
The information provided is appropriate	84	16	-	-	85	15	-	-
The website is easy to use	81	19	-	-	81	19	-	-
Pictures, animations are satisfactory	60	26	14	-	72	23	5	-
The information provided is useful	70	30	-	-	72	28	-	
The website can be recommended to friends	79	21	-	-	84	16	-	
The website is an effective educational tool	82	18	-	-	80	20	-	-
The website requires further changes	-	-	24	76	-	-	12	88

Key: SA = Strongly Agree, A= Agree, UD= Undecided, D= Disagree

Seventy seven non-nutrition students and 81 nutrition students strongly agreed that the website was interesting, while the remaining 23 non-nutrition students and 19 nutrition students expressed agreed on this. Eighty non-nutrition students and 83 nutrition students strongly agreed that the website was

easy to understand while 20 non-nutrition students and seventeen nutrition students agreed on this view. Eighty four non-nutrition students and 16 nutrition students strongly agreed that the information provided was appropriate. Sixteen students and 15 students of non-nutrition and nutrition groups respectively agreed on this view. Similarly, 81 students of both non-nutrition and nutrition groups expressed strong agreement on the view that the website was easy to use, while 19 students of both non-nutrition and nutrition groups agreed on this view. Sixty non-nutrition students and 72 nutrition students strongly agreed that the pictures, animations provided were satisfactory, while 26 non-nutrition students and 23 nutrition students agreed on this view, whereas the remaining 14 non-nutrition students and 5 nutrition students were undecided about this. Seventy non-nutrition students and 72 nutrition students strongly agreed that the information provided was useful, while the remaining students agreed on this view. Seventy nine non-nutrition students and 84 nutrition students strongly agreed that the website can be recommended to friends, while 21 students and 16 students of non-nutrition and nutrition groups respectively agreed on this. Eighty two non-nutrition students and 80 nutrition students strongly agreed that the website was an effective educational tool, and 18 non-nutrition students and 20 nutrition students agreed on this. Twenty four students of both non-nutrition and nutrition groups were undecided on whether the website required further changes, and the remaining 76 students of non-nutrition and nutrition groups disagreed that the website required further changes.

V SUMMARY AND CONCLUSION

The present study titled “Developing an interactive nutrition website and evaluating its effectiveness among adolescent girls” is summarized as follows:

Adolescence is a period of rapid linear growth, altered body composition, reproductive maturation and psychosocial development. Nutrient requirements are increased to meet the demands of growth and development.

Among adolescents, the Internet has become indispensable for various instrumental purposes. Use of Internet is an innovative way to address the problem of poor nutrition on college campus.

Two hundred adolescent girls in the age group of 17 to 20 years which included 100 Non-Nutrition students and 100 Nutrition students belonging to I, II, and III year Undergraduate courses and I year postgraduate courses were selected from the departments of Food Science and Nutrition, English, and Computer Science.

An informative, interactive nutrition website was developed with the domain name www.nutrition-ijkl.com. The website developed included information on basic food groups; importance of nutrition to adolescents, growth and development, nutrient requirements, nutritional problems, special situations, ICMR recommended daily allowances, Body Mass Index calculations and nutrient calculations.

The website was developed using Hypertext Markup Language (HTML), Cascading Style Sheets (CSS) and Adobe Photoshop. The calculations and the questionnaire were computed using PHP: Hypertext Preprocessor and JavaScript. The software application used to create HTML for the nutrition website was Dreamweaver.

The selected students were instructed to visit the developed nutrition website and changes in their nutrition knowledge were evaluated.

The findings of the study are summarized as follows:

- It was observed that among 100 non-nutrition students, 34 students belonged to the age group of 17 years, followed by 23 students in both the age group of 18 and 19 years, followed by 20 students in the age group of 20 years. Among the nutrition students, 32 students belonged to the age group of 19 years, 30 students belonged to the age group of 17 years, 28 students belonged to the age group of 18 years and only 10 students of them were 20 years old.
- Eighty non-nutrition students and 89 nutrition students belonged to nuclear families and 20 students and 11 students of non-nutrition and nutrition groups belonged to joint families respectively.
- With regard to the family size, 11 non-nutrition students and six nutrition students belonged to families consisting of three members. The number of non-nutrition students who belonged to families consisting of four members was 58 and nutrition students were 54 in number, followed by families consisting of five members were 23 non-nutrition students and 18 nutrition students. The number of non-nutrition students who belonged to families consisting of six members was 8 and non-nutrition students were 12 in number.
- Among the surveyed group, it was found that head of the families of 22 non-nutrition students and head of the families of 12 nutrition students were agriculturists, whereas head of the families of 19 non-nutrition students and head of the families of 25 nutrition students were businessmen, head of the families of 9 non-nutrition students and head of the families of 15 nutrition students were executives, head of the families of 8 non-nutrition students and head of the families of 18 nutrition students were Government Employees and head of the families of 34 non-nutrition students and head of the families of 30 nutrition students were labourers.

- Forty one families of non-nutrition students and 33 families of nutrition students had a monthly income of more than Rs.14,500, whereas 34 families of both non-nutrition and nutrition groups had a monthly income of more than Rs.7300 but less than Rs.14500, 24 and 28 families of non-nutrition and nutrition students had more than Rs.3300, but less than Rs.7300 and one family of non-nutrition and five families of non-nutrition group had a monthly income of more than Rs.3000 but less than Rs.7300.
- Among non-nutrition group, 12 students did physical activity and yoga to stay healthy, followed by 9 students who did meditation, and only 8 students followed diet modification to stay healthy. Among nutrition group, 32 students did physical activity to stay healthy, followed by 30 students who followed diet modification, followed by 16 students who did yoga and 15 students who did meditation to stay healthy. Sixty three non-nutrition students and 17 nutrition students did not indulge in any activities to stay healthy.
- Among the surveyed group, it was found that 94 non-nutrition students and 86 nutrition students had not attended diet counselling, while 6 non-nutrition students and 11 nutrition students had attended diet counselling.
- Sixty six non-nutrition students and 99 nutrition students obtained their nutrition information from school or college. Fifty three non-nutrition students and sixty three nutrition students obtained their nutrition information from their peers or friends. Sixty two non-nutrition students and 58 nutrition students obtained their nutrition information from their parents. Sixty three non-nutrition students and 62 nutrition students obtained their nutrition information from radio or television or magazines, while 63 non-nutrition students and 71 nutrition students obtained their nutrition information from the internet.

- Eighteen non-nutrition students and 6 nutrition students consumed vegetarian diet, 79 non-nutrition students and 83 nutrition students consumed non-vegetarian diet, followed by 3 non-nutrition and eleven nutrition students who consumed ova-vegetarian diet.
- Eighty non-nutrition students and 74 nutrition students followed a three meal pattern and 14 non-nutrition students and 7 nutrition students followed a two meal pattern, and the remaining 6 non-nutrition students and 19 nutrition students followed four meal patterns per day.
- It was observed that 43 non-nutrition students and 44 nutrition students skipped breakfast. Among the selected group, two non-nutrition students and eleven nutrition students skipped their lunch respectively, which is surprising and 3 students of both non-nutrition and nutrition group skipped their dinner. Fifty two non-nutrition students and forty two nutrition students did not skip their meals.
- Among non-nutrition students, 73 per cent expressed time constraints as the major reasons for missing their meals. Among the nutrition students, 69 per cent expressed time constraints as the major reason for missing their meals. Twenty seven per cent of non-nutrition and thirty one per cent of nutrition students skipped their meals due to fasting.
- It is revealed that, fifty six per cent of non-nutrition students and 45 per cent of nutrition students skipped their meals once/twice a week. Nineteen per cent of non-nutrition students and 14 per cent of nutrition students skipped their meals daily., whereas 25 per cent of non-nutrition students and 41 per cent of nutrition students skipped their meals occasionally. It is surprising to know that almost an equal number of non-nutrition and nutrition students skipped their breakfast.

- It is revealed that 29 per cent of non-nutrition students and 31 per cent of nutrition students consumed fruit juices to compensate their skipped meals, 58 per cent and 21 per cent of non-nutrition and nutrition students preferred snacks to compensate the skipped meals, 11 per cent and 26 per cent of non-nutrition and nutrition students preferred whole fruits to compensate their skipped meals respectively. The remaining two percent of non-nutrition and twenty two percent of nutrition students never compensated for their skipped meals.
- It is observed that all the students of both non-nutrition and nutrition group consumed cereals, fats and oils, spices and condiments and sugar daily. Seventy two non-nutrition students and 82 nutrition students consumed pulses daily, while 28 non-nutrition and 18 nutrition students consumed pulses weekly.
- Seventeen students of both non-nutrition and nutrition group ate green leafy vegetables daily. Fifty three non-nutrition students and 54 nutrition students ate green leafy vegetables weekly, while 30 non-nutrition students and 29 nutrition students took green leafy vegetables rarely. Fifty three non-nutrition and fifty one nutrition students consumed other vegetables daily, while 38 non-nutrition students and 40 nutrition students consumed other vegetables weekly and the remaining 9 students of both non-nutrition and nutrition group consumed other vegetables rarely. Twenty four non-nutrition students and 27 nutrition students consumed roots and tubers daily, while 42 non-nutrition students and 54 nutrition students consumed roots and tubers weekly, and the remaining 34 non-nutrition students and nine nutrition students consumed roots and tubers rarely.
- Seventy seven non-nutrition students and 89 nutrition students consumed milk and milk products daily, while 17 non-nutrition students and two nutrition students consumed milk and milk products

weekly, and the remaining six non-nutrition and nine nutrition students consumed milk and milk products rarely.

- Among seventy nine per cent of non-nutrition students consuming non-vegetarian foods, one per cent and six percent of students consumed meat and fish and other sea foods daily respectively, while 66 per cent and 65 per cent of students consumed meat and fish and other sea foods weekly respectively and 33 per cent and 29 per cent of students consumed meat and fish and other sea foods rarely respectively.
- Among eighty three per cent of nutrition students consuming non-vegetarian foods, five percent and two per cent of students consumed meat and fish and other sea foods daily respectively, while 60 per cent and 63 per cent of students consumed meat and fish and other sea foods weekly respectively, and the remaining 36 per cent and 35 per cent of students consumed meat and fish and other sea foods rarely respectively.
- Among eighty two per cent of non-nutrition students who consumed non-vegetarian foods and only egg, 28 per cent of students consumed egg daily, while 18 per cent of students consumed egg weekly and 54 per cent of students consumed egg rarely.
- Among ninety four per cent of nutrition students who consumed non-vegetarian foods and only egg, 31 per cent of students consumed egg daily, while 25 per cent of students consumed egg weekly and the remaining 44 per cent of students consumed egg rarely.
- Forty two non-nutrition students and 56 nutrition students ate oilseeds and nuts weekly, while the remaining 58 non-nutrition students and 44 nutrition students ate oilseeds and nuts rarely.

- Twelve non-nutrition students and six nutrition students consumed hotel/canteen foods daily, while 40 non-nutrition students and 35 nutrition students consumed hotel/canteen foods weekly, and the remaining 48 non-nutrition students and 59 nutrition students consumed hotel/canteen foods rarely. Ten non-nutrition students and five nutrition students consumed fast foods daily, while 38 non-nutrition students and 40 nutrition students consumed fast foods weekly, and the remaining 52 non-nutrition students and 55 nutrition students consumed fast foods rarely. Thirty five non-nutrition students and 15 nutrition students consumed sweets daily, while 40 non-nutrition students and 63 nutrition students consumed sweets weekly, and the remaining 25 non-nutrition students and 22 nutrition students consumed sweets rarely.
- Eighty three students and 23 students of non-nutrition group consumed snacks and soft drinks daily respectively, while 17 students and 37 students of non-nutrition group consumed snacks and soft drinks weekly respectively, and the remaining 40 non-nutrition students consumed soft drinks rarely. Eighty students and 8 students of nutrition group consumed snacks and soft drinks daily respectively, while 20 students and 32 students of nutrition group consumed snacks and soft drinks weekly respectively, and the remaining 60 nutrition students consumed soft drinks rarely.
- It is revealed from the study that 90 non-nutrition students and 92 nutrition students liked fruits, 83 non-nutrition students liked snacks and soft drinks and 75 students and 72 students of nutrition group liked snacks and soft drinks respectively. Eighty eight students and 87 students of non-nutrition group liked sugar and sweets respectively. Seventy seven students and 73 students of non-nutrition group liked hotel/ canteen foods and fast foods respectively, while 69 students and 74 students of nutrition group liked hotel/canteen foods.

Eighty four non-nutrition students and 91 nutrition students liked milk and milk products.

- Seventy five students and 78 students of non-nutrition group liked green leafy vegetables and other vegetables respectively. Eighty six students and 82 students of nutrition group liked green leafy vegetables and other vegetables respectively.
- Among the non-nutrition group, 90 students browsed the internet, and only ten students did not browse the internet. Among the nutrition group, 97 students browsed the internet and only three students did not browse the internet.
- Forty four per cent of non-nutrition students and 55 per cent of nutrition students spend less than one hour in browsing daily, while 37 per cent of non-nutrition students and 40 per cent of nutrition students spend more than one hour but less than two hours in browsing daily, while the remaining 19 per cent of non-nutrition students and 5 per cent of nutrition students spend more than two hours in browsing daily.
- It is revealed that 95 per cent of non-nutrition students and 87 per cent of nutrition students used internet as educational tool. Eleven per cent of nutrition students used internet for recreational purpose. Forty eight per cent of non-nutrition students and 25 per cent of nutrition students used internet for social networking, while only 23 per cent of nutrition students used internet for health information, and non-nutrition students did not use internet for getting health information.
- Among non-nutrition students, 83 per cent of students did not access nutrition websites, while only 17 per cent of students visited nutrition websites. Sixty two per cent of nutrition students accessed nutrition

websites, while 38 per cent of students did not visit nutrition websites.

- Ninety six per cent of non-nutrition students and ninety one per cent of nutrition students had not accessed online diet counselling, while four per cent of non-nutrition students and nine percent of nutrition students had accessed online diet counselling.
- It is revealed that 68 non-nutrition students and 64 nutrition students preferred internet learning for nutrition learning, while only 32 non-nutrition students and 36 nutrition students preferred lecture on nutrition.
- The results revealed that there is significant difference at one per cent level in the initial nutritional knowledge of the nutrition students when compared with non-nutrition both before imparting nutrition education and after imparting nutrition education through nutrition website. The nutrition students showed higher scores than the non-nutrition students.
- After imparting nutrition education through nutrition website, it was observed that nutritional knowledge of both non-nutrition and nutrition student showed a positive improvement. The mean scores before education among non-nutrition students and nutrition students were 9.6 and 13.47 respectively, and after imparting education through nutrition website, it had increased to 14.84 and 15.88 for non-nutrition and nutrition students respectively. The knowledge gained in terms of scores by the non-nutrition and nutrition students showed significant improvement at one per cent level after the students had gained nutritional knowledge, on viewing the nutrition website.
- Seventy seven non-nutrition students and 81 nutrition students strongly agreed that the website was interesting, while the remaining

23 non-nutrition students and 19 nutrition students expressed agreed on this. Eighty non-nutrition students and 83 nutrition students strongly agreed that the website was easy to understand while 20 non-nutrition students and seventeen nutrition students agreed on this view. Eighty four non-nutrition students and 16 nutrition students strongly agreed that the information provided was appropriate. Sixteen students and 15 students of non-nutrition and nutrition groups respectively agreed on this view. Similarly 81 students of both non-nutrition and nutrition groups expressed strong agreement on the view that the website was easy to use, while 19 students of both non-nutrition and nutrition groups agreed on this view. Sixty non-nutrition students and 72 nutrition students strongly agreed that the pictures, animations provided were satisfactory, while 26 non-nutrition students and 23 nutrition students agreed on this view, whereas the remaining 14 non-nutrition students and 5 nutrition students were undecided about this. Seventy non-nutrition students and 72 nutrition students strongly agreed that the information provided was useful, while the remaining students agreed on this view.

- Seventy nine non-nutrition students and 84 nutrition students strongly agreed that the website can be recommended to friends, while 21 students and 16 students of non-nutrition and nutrition groups respectively agreed on this. Eighty two non-nutrition students and 80 nutrition students strongly agreed that the website was an effective educational tool, and 18 non-nutrition students and 20 nutrition students agreed on this. Twenty four students of both non-nutrition and nutrition groups were undecided on whether the website required further changes, and the remaining 76 students of non-nutrition and nutrition groups disagreed that the website required further changes.

It can be concluded that imparting nutrition education through website to adolescent girls irrespective of nutrition and non-nutrition students had a positive impact in increasing their nutritional knowledge.

Recommendations

From the findings of the study the following recommendations are made

- Computer based nutrition education tools can be developed to educate the community.
- Internet-delivered diet counselling can be given to the adolescents, pregnant and lactating women and as diet therapy.
- The internet nutrition software for planning meals by caloric requirements can be developed.
- Internet-tailored nutrition program can be developed for college students.

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<http://www.who.int/en/>

www.springerlink.com

www.pubmed.com

http://www.epi.umn.edu/let/pubs/adol_book.shtm

<http://www.biomedcentral.com/1471-2458/12/881>

<http://www.pewinternet.org/>

<http://cjlt.csj.ualberta.ca/index.php/cjlt/article/view/26/24>

<http://health.india.com/news/nearly-50-per-cent-of-indias-adolescent-girls-underweight-unicef-report-card-on-adolescents/>

APPENDIX I
**INTERVIEW SCHEDULE TO ELICIT SOCIO-ECONOMIC
 BACKGROUND AND INTERNET USAGE OF THE ADOLESCENT
 GIRLS**

Socio Economic Background

- 1) Name
- 2) Age in years and Date of Birth
- 3) Educational Qualification
- 4) Name of the Department
Class
- 5) Details of Residence
 - a) Home b) Hostel c) Guardian
Permanent Address

Phone No.

- 6) Type of family
 - a) Joint b) Nuclear
- 7) Composition of the family

S.No	Name of the family members	Relationship with the subject	Gender	Age (year)	Education	Occupation	Monthly Income

- 8) What do you do to stay healthy?
 - a) Yoga b) Meditation c) Physical Activity d) Diet modification
- 9) Have you attended any diet counseling?
 - a) Yes b) No
- 10) From where do you get your information about Nutrition?

Source	Yes	No
School/College		
Peers/ Friends		
Parents		
Radio/TV/Magazines		
Internet		

General Dietary Pattern

- 11) Type of diet consumed
 - a) Vegetarian b) Non-vegetarian c) Ova-vegetarian
- 12) Type of meal pattern followed (Tick the appropriate column)

Meal Pattern	Breakfast	Lunch	Evening	Dinner
2 meal				
3 meal				
4 meal				

- 13) Do you skip any meal? a) Yes b) No
If yes, which meal
 - a) Breakfast b) Lunch c) Dinner
 Why?

a) Time constraints b) Fasting c) Others (Specify)

Frequency with which you skip meal?

a) Daily b) Once/ Twice in a week c) Occasionally

14) How do you compensate when you skip the meal?

a) By drinking fruit juices c) By eating whole fruits

b) By eating some snacks d) others (Specify)

15) Check list for Food Use Frequency

S.No	Food Groups	Daily	Weekly	Rarely
1	Cereals			
2	Pulses			
3	Green leafy vegetables			
4	Other vegetables			
5	Roots and Tubers			
6	Fruits			
7	Milk & Milk products			
8	Meat			
9	Fish & sea foods			
10	Egg			
11	Fats & oils			
12	Oilseeds & nuts			
13	Sugar			
14	Spices & condiments			
15	Hotel/ Canteen foods			
16	Fast foods			
17	Sweets			
18	Snacks			
19	Soft drinks			

16) Check list for Food Preference

S.No.	Food Groups	Daily	Weekly	Rarely
1	Cereals			
2	Pulses			
3	Green leafy vegetables			
4	Other vegetables			
5	Roots and Tubers			
6	Fruits			
7	Milk & Milk products			
8	Meat			
9	Fish & sea foods			
10	Egg			
11	Fats & oils			
12	Oilseeds & nuts			
13	Sugar			
15	Hotel/ Canteen foods			
16	Fast foods			
17	Sweets			
18	Snacks			
19	Soft drinks			

Internet Use

- 1) Do you go for internet browsing?
 - a) Yes b) No
- 2) If yes, how many hours do you spend daily in browsing?
 - a) < 1 hour b) 1-2 hours c) > 2 hours
- 3) For what purpose, do you use internet?
 - a) Educational tool b) Recreational tool c) Social networking
 - d) Health information
- 4) Do you visit Nutrition websites?
 - a) Yes b) No
- 5) List few Nutrition websites that you have visited.

- 6) Why do you visit Nutrition websites?

- 7) Have you accessed online diet counseling?
 - a) Yes b) NoIf yes, for what?
- 8) Have you found online diet counseling useful to you?
 - a) Yes b) No
- 9) Do you want to include anything else for online diet counseling?
 - a) Yes b) NoIf yes, list your suggestions

- 10) Which of the following do you prefer for nutrition learning?
 - a) Lecture on Nutrition b) Internet learning

APPENDIX II

QUESTIONNAIRE TO ASSESS THE NUTRITIONAL KNOWLEDGE

Please tick the right answer

- 1) Green leafy vegetables are rich in
a) Iron b) Fat c) Calorie d) Protein
- 2) Name the food which is rich in vitamins and minerals
a) Fruits and vegetables b) Sugar c) Rice d) Oily foods
- 3) Indicate the food rich in fibre
a) Fruits b) Rice c) Meat d) Oil
- 4) Yellow coloured vegetables and fruits are rich in
a) Beta carotene b) Carbohydrate c) Fat d) Protein
- 5) Junk foods are rich in
a) Carbohydrate b) Protein c) Fat d) Vitamins
- 6) Why should we increase iron intake during adolescence?
a) To increase weight c) For bone development
b) To overcome anaemia d) To improve body mass
- 7) Vitamin A is needed for
a) Vision b) Weight-gain c) Brain development
d) Bone development
- 8) Iron is essential for
a) Heamoglobin synthesis c) Growth
b) Vision d) Bone development
- 9) Tick the junk food among the following
a) Fruits b) Bread c) Pizza d) Idli
- 10) Indicate the benefits of fibre
a) Reduces cholesterol level c) Increase weight
b) Increase body mass d) Decreases blood level
- 11) Indicate the food rich in calcium
a) Cereals b) Pulses c) Milk & Milk products d) Fats&oils
- 12) Vitamin C is abundantly available in
a) Pulses b) Citrus fruits c) Oil d) Cereals
- 13) Osteoporosis occurs due to the deficiency of
a) Iron b) Calcium c) Protein d) Vitamin
- 14) Anaemia occurs due to the deficiency of
a) Calcium b) Iron c) Vitamin A d) Carbohydrates
- 15) Which is the antioxidant vitamin?
a) Vitamin K b) Vitamin A c) Vitamin D d) Vitamin E
- 16) What is a 'Balanced diet'?
a) A diet rich in protein c) A diet without carbohydrates
b) A diet poor in fat d) A diet containing all nutrients in proper quantities

APPENDIX-IV
TOTAL SCORES OBTAINED BY THE ADOLESCENT GIRLS
BEFORE AND AFTER THE NUTRITION EDUCATION
NON-NUTRITION STUDENTS

S.No.	Before	After	S.No.	Before	After	S.No.	Before	After
1	12	16	35	8	15	69	9	15
2	15	16	36	9	15	70	4	14
3	16	16	37	7	15	71	8	14
4	10	15	38	9	15	72	9	15
5	16	16	39	14	16	73	5	14
6	12	16	40	3	13	74	6	14
7	15	16	41	14	16	75	5	15
8	16	16	42	7	15	76	5	15
9	15	16	43	5	14	77	8	15
10	15	16	44	7	14	78	7	15
11	15	16	45	5	13	79	5	14
12	11	16	46	8	12	80	5	10
13	5	14	47	6	15	81	3	11
14	10	15	48	16	16	82	4	12
15	11	16	49	5	14	83	5	11
16	11	16	50	9	15	84	6	15
17	10	15	51	9	15	85	5	12
18	15	16	52	16	16	86	4	12
19	12	16	53	12	16	87	11	16
20	10	15	54	15	16	88	5	13
21	10	16	55	16	16	89	9	16
22	7	15	56	12	16	90	6	15
23	10	16	57	13	16	91	4	12
24	8	15	58	12	16	92	3	12
25	9	15	59	14	16	93	7	15
26	14	16	60	12	16	94	5	12
27	3	10	61	13	16	95	10	16
28	14	16	62	14	16	96	4	12
29	9	15	63	13	16	97	8	14
30	7	15	64	12	16	98	9	16
31	9	15	65	15	16	99	15	16
32	9	15	66	13	16	100	15	16
33	16	16	67	13	16			
34	5	12	68	9	15			

NUTRITION STUDENTS

S.No.	Before	After	S.No.	Before	After	S.No.	Before	After
1	7	16	35	12	16	69	16	16
2	14	16	36	14	16	70	16	16
3	15	16	37	11	16	71	9	16
4	13	16	38	16	16	72	15	16
5	14	16	39	16	16	73	15	16
6	14	16	40	16	16	74	13	16
7	15	16	41	15	16	75	16	16
8	13	16	42	10	16	76	16	16
9	11	16	43	16	16	77	15	16
10	14	16	44	16	16	78	15	16
11	12	16	45	16	16	79	7	15
12	12	16	46	16	16	80	16	16
13	11	16	47	9	15	81	16	16
14	16	16	48	7	15	82	16	16
15	16	16	49	16	16	83	16	16
16	5	16	50	7	15	84	15	16
17	9	16	51	12	16	85	16	16
18	9	16	52	15	16	86	16	16
19	16	16	53	12	16	87	14	16
20	15	16	54	16	16	88	15	16
21	12	16	55	7	15	89	15	16
22	9	15	56	16	16	90	16	16
23	15	16	57	16	16	91	16	16
24	9	15	58	16	16	92	13	16
25	15	16	59	15	16	93	12	16
26	7	15	60	9	15	94	7	16
27	14	16	61	16	16	95	15	16
28	15	16	62	16	16	96	16	16
29	13	16	63	11	16	97	16	16
30	14	16	64	16	16	98	15	16
31	14	16	65	15	16	99	16	16
32	15	16	66	12	16	100	14	16
33	16	16	67	7	14			
34	15	16	68	9	15			