ANNEXURE – I

The Principal

……................................…. School

Dated: …........................…

Subject: Regarding permission to conduct a survey on students of your institute.

Sir/Madam

Most humbly, I **Neetu Saini**, research scholar, Pacific Academy of Higher Education and Research University, Udaipur, want to state that I need certain data of school going children from class VI to XII regarding my research work titled **"Evaluation of Physical Growth Standards, Nutritional Status and Dietary Patterns among the School Age-Children of Himachal Pradesh: A Cross Sectional Study".** The survey includes measuring of height and weight of the students and a questionnaire seeking information on their personal details and the dietary pattern. The survey does not involve any invasive procedure. Moreover, the teachers may also be present during the survey. I therefore request to kindly grant me permission to conduct the abovementioned survey.

I shall be highly indebted to you.

Thanking you

Yours faithfully

Neetu Saini

ANNEXURE – II

INFORMED CONSENT DOCUMENT
PART I

Information to be provided to participants / legally acceptable representative of participants in case they are minor or likely to be deemed incompetent to consent on their own.

Title of the study: "Evaluation of Physical Growth Standards, Nutritional Status and Dietary Patterns among the School Age-Children of Himachal Pradesh: A Cross Sectional Study".

What is the purpose of this study?

The purpose of the study is to access the physical growth status, nutritional status, dietary pattern and its association with nutritional status among school-going children of Himachal Pradesh.

Who are the participants and how many participants are likely to be there?

The participants included in the study are students from class VI to class XII. The study intends to have number of participants up to 1000.

Why have I been chosen?

You are the student of desired age group for the proposed research.

Do I necessarily have to take part?

Taking part in this study is voluntary, however, your participation will be a great help to the researcher and will be highly appreciated.

What happens during the study / What do I have to do? (the procedures, such as answering a questionnaire, which the participant will have to undergo)

Students are requested:

1. To go through their measurement of height and weight with the help of anthropometric rod and weighing machine in the presence of researcher and teacher.

2. To answer a questionnaire based on personal details and dietary patterns of the subjects.

What are the possible benefits of taking part?

Your participation may help to determine the health status of school aged children as well as the nutritional status and dietary pattern of Himachali children which may further create a health awareness among the students in general.

Are there any possible disadvantages of taking part?

No, not at all as the study does not involve any invasive procedure.

Are there are any monetary costs involved in participation?

No, there are no monetary costs involved in participation.

Will my taking part in this study be kept confidential?

Yes.

What will happen to the results of the study?

With the help of results, we may. prepare a report on nutritional status of school-going Himachali children and compare it with children of other states. We may even recommend its implications to the government and health authorities.

Any other information relevant to participation in the study such as sponsorship:

No.

A statement thanking the participant for going through the informed consent document.

I would like to express my deepest appreciation and thanks to the dear subjects for their wholehearted cooperation and participation during the research.

Contact for further information (the name designation and contact numbers of Principal Investigator)

Neetu Saini, (Assistant Professor, Govt. Degree College Mandi Himachal Pradesh). Ph.D. Scholar, Pacific Academy of Higher Education and Research University, Udaipur.

PART 2

INFORMED CONSENT FORM

I. EVALUATION OF PHYSICAL GROWTH STANDARDS, NUTRITIONAL STATUS AND DIETARY PATTERNS AMONG THE SCHOOL AGE-CHILDREN OF HIMACHAL PRADESH: A CROSS SECTIONAL STUDY.

Informed Consent Document Version No. and Date

Subject's: Name: _____ **ID No.** _____ **Age** _____ **Sex** _____

Please tick if you agree

1. I confirm that I have read and understood the information sheet for the above ❏
   study dated _____ and have had the opportunity to ask questions.

2. I understand that my participation in the study is voluntary and that I am free ❏
   to withdraw at any time, without having to give a reason, and without my
   rights and privileges being affected.

3. I understand that my data would be kept confidential but individuals ❏
   authorized by the Principal Investigator, the ethics committee of the institute
   where the study will be conducted and government regulatory authority will
   have access to my records both in respect of the current study and further
   research that may be conducted in relation to it. Even if I withdraw, I agree to
   this access. However, I understand that my identity will not be revealed and
   confidentiality of information will be maintained.

4. I agree not to restrict the use of any data or results that arise from this study ❏
   for academic purpose.

5. I agree to voluntarily take part in the above study. ❏

Signature / Thumb impression of the subject or a legally acceptable representative (LAR):

_____ **Date:** _____ **Signatory's name**: _____

Study investigator's signature: _____ **Date:** _____

Study investigator's name: _____

ANNEXURE – III

Questionnaire

1. Reference Number:

Date and Place

Date of survey: Place:

Name of school:

Address of the school:

Location of the school:

Type of school: (Pvt) / govt

Personal Information

Name of student:

Date of birth:

Class:

Address:

Contact Number:

Physical Parameters

Age:

Height:

Weight:

BMI:

z-score for Height for age:

z-score for BMI for age:

Nutritional Category:

DIETARY PATTERN

How often do you have the following food items during the last 15 days

Food item	Daily	Most days a week (≥4 days)	Few days a week (≤ few days)	Once in a week and Never
Fruits				
Milk				
Dairy				
Green and Leafy vegetable				
Cooked vegetable				
Salad				
Pulses				
Savory snacks				
Fast foods				
Sweet				
Cake and pastries				
Candy and chocolate				
Soft drink				

What is diet Pattern: Veg   Non-Veg

How frequently you had your breakfast in last 15 days.

Daily   Most days a week   Few days a week   Never

प्रश्नावली

1 संदर्भ संख्या :	
दिनांक और स्थान	
सर्वेक्षण की तिथिः	स्थानः
पाठशाला का नामः	
पाठशाला का पताः	
पाठशाला का स्थान निर्धारणः	
पाठशाला का प्रकारः	गैर सरकारी / सरकारी
व्यक्तिगत सूचना	
विद्यार्थियों का नामः	
जन्म तिथि :	
कक्षा :	
पता :	
संपर्क संख्याः	
शारीरिक माप :	
आयुः	
लंबाईः	
वजनः	
शरीर विद्यमान सूचकांकः	
आयु की ऊंचाई के लिए जेड–स्कोरः	
उम्र की बीएमआई के लिए जेड–स्कोरः	
पोषक श्रेणीः	

आहार प्रतिरूप

पिछले 15 दिनों के दौरान आपने कितनी बार निम्नलिखित खाद्य पदार्थ खाए

खाद्य – सामग्री	प्रतिदिन सप्ताह में अधिकांश दिन > =4 दिन	सप्ताह में कुछ दिन < 4 दिन	सप्ताह में एक बार और कभी नहीं
फल			
दूध			
दुग्धालय			
हरि और पत्तेदार सब्जियां			
पकी हुई सब्जियाँ			
सलाद			
दाल			
स्वादिष्ट स्नैक्स (अल्पाहार)			
फास्ट फूड (शीघ्र तैयार किया जाने वाला भोजन)			
मिठाई			
केक और पेस्ट्री			
कैंडी और चॉकलेट			
शीतल पेय (ठंडा)			

आहार प्रतिरूप क्या है: शाकाहारी मांसाहारी

पिछले 15 दिनों में आपने कितनी बार नाश्ता किया :

प्रतिदिन सप्ताह में अधिकांश दिन सप्ताह में कुछ दिन कभी नहीं

Original Research Article

Assessment of nutritional status of adolescent school going boys of Himachal Pradesh

Neetu S. Pathania[1], Rajib Biswas[2]*

[1]Department of Chemistry, Pacific University, Udaipur, Rajasthan, India
[2]Department of Physiology, Himachal Dental College, Sundernagar, Mandi, Himachal Pradesh, India

*Correspondence:
Dr. Rajib Biswas,
E-mail: ergoraj@gmail.com

ABSTRACT

Background: Given the paucity of data on the nutritional standard of the Himachali children, the present study was conducted to assess the physical growth and malnutrition of adolescent school-going boys of Himachal Pradesh within the age group of 15-17 years.
Methods: Boys were selected from both government and private schools of the non- hilly regions of Mandi district of Himachal Pradesh. Height, weight, and BMI were determined. Stunting was evaluated from height-for-age Z-score, and thinness, overweight, and obesity were estimated from BMI-for-age Z-score using the WHO recommended cut-off values.
Results: Mean height varied between 167.2 to 168.7 cm. Weight varied between 52.4 to 56.1 kg with a corresponding BMI between 18.7 to 19.7 kg/m^2.The overall prevalence of stunting and wasting were 5.7% and 15.8% respectively. The coexistence of stunting and wasting was not found in any of the age groups. The overall prevalence of overweight and obesity was 5.4% and 1.7% respectively.
Conclusions: Himachali boys appeared to be taller than most of the Indian population of boys of similar age groups. Prevalence of the different categories of over nutrition and undernutrition were also lower as compared to that obtained for other Indian studies on adolescent boys. The existence of overweight and obese individuals points towards the double burden of malnutrition.

Keywords: Physical growth, Malnutrition, Stunting, Thinness, Adolescent, India

INTRODUCTION

Growth is the most fundamental survival mechanism. Physical growth is a complex and continuous process of physical development by which an infant develops into an adult. It involves a progressive development in terms of physical size and morphology which commences through different phases and can be described as growth during infancy, childhood, and adolescence. Height and weight are considered the two most fundamental and sensitive anthropometric indicators of physical growth. In each phase of development the height and weight increase at a particular pace. Therefore, growth monitoring for infants, children, and adolescents, is fundamentally based on the measurement of these two parameters. Growth monitoring can assess the physical growth profile for a group of population in terms of presence and extent of growth problem and thereby reveals conditions of malnutrition. Subsequently, this provides an opportunity to take preventive and supportive actions to promote proper nutrition for the betterment of health and well-being.

However, to detect various clinical and sub-clinical forms of growth deficiencies and malnutrition, only height and

weight values do not help. Therefore the height and weight data need transformation to suitable indices. Growth indices are constructed by combining height and weight with age and sex.[1] Three sex and age-specific indices are most commonly used for the evaluation of growth and nutritional status in children and adolescents up to 19 years of age. They are height-for-age (HAZ), BMI-for-age (BMIAZ) and weight-for-age (WAZ).[2]

The Height-for-age (HAZ) is a height-based indicator and indicates linear growth. It compares whether a child or adolescent has achieved the expected level of height as compared to a child from a healthy well-nourished reference population of the same age. A low HAZ indicates a short stature condition as compared to age which is called stunting or linear growth retardation and reflects a state of chronic malnutrition. Body mass index (BMI) is used to identify if an individual has an abnormal weight in proportion to their height. BMI-for-age (BMIAZ) is a weight-based index that assesses both over and undernutrition.

The BMIAZ compares the BMI of a child, at a particular age with the BMI of a child representing the reference population of a similar age group. Given that the BMI reflects relative fatness of the body, BMIAZ identifies conditions of overnutrition that include overweight and obesity. Both overweight conditions and obesity are considered as chronic states of malnutrition.Furthermore, low BMIAZ scores indicate a condition of undernutrition termed as "thinness" or "wasting". BMIAZ has been recognized as the best direct indicator of thinness during adolescence.[3] Thinness directly indicates an acute state of malnutrition.[4] Several studies have estimated the height and weight trends and the prevalence of different categories of malnutrition among Indian adolescents across diverse socio-demographic and economic conditions.[5-13] The reports of these From these studies, it appeared that there is a significant prevalence of malnutrition among the adolescent population of different Indian states.

Himachal Pradesh is the most progressive hilly state of India. It has its own geographically unique, isolated lifestyle and culture that differs considerably from the majority of Indian states. Furthermore, the state has undergone a socio-economic transformation during the last two decades. It is a well-established fact that the economic status is a major determinant of nutritional status of the community and socio-cultural and economic transition can affect the nutritional standard of particularly the children and the adolescent.[14] To date, there is a paucity of data regarding the physical growth standard and malnutrition of the Himachali adolescent population. Only a few studies have reported on the anthropometric profile of Himachali children and adolescents.[15-18] These studies were conducted on children below 15 years of age.

Against this backdrop, the present study was conducted among the adolescent school-going boys of Himachal Pradesh aged 15-17 years. This age group represents the late adolescent period and to date, very few studies have reported the nutritional standard of boys belonging to this age group. The present study is aimed to evaluate the physical growth standard of 15-17 years boys in terms of height and weight. The study also intends to report the prevalence of different categories of malnutrition among these boys.

METHODS

Study design and location

A cross-sectional survey design was adopted in the present study which was conducted in the Mandi district of Himachal Pradesh. To avail the logistic advantage, a wider range of geographical locations including hilly regions of the districts were excluded and only the non-hilly zones and valley regions of the districts were selected. This includes three subdivisions of Mandi district; Mandi Sadar, Balh, and Sundernagar. These zones cover urban, peri-urban, and as well as rural areas.

Subjects

A total number of 298 boys were selected from both the government and private schools. The children suffering from any type of chronic disease or those who reported any illness during the last one month before the survey date were excluded from the study. Before the study, all the students were explained about the purpose of the study and the extent of their involvement in presence of the respective class teachers. The same was also conveyed to their parents through the class teachers.

Physical measurement

Determination of age: the date of birth (DOB) was obtained from the school register which is based on the birth certificate presented at the time of admission. From this DOB, the exact age at the time of admission was obtained and expressed as year and month. Determination of height: height was measured with an anthropometric rod with shoes removed and head aligning in the Frankfurt plane. Readings were taken to the nearest 1 cm. Determination of weight: weight was measured in kg by using a bathroom scale with minimum clothing and shoes removed to the nearest 500 grams. Determination of BMI: BMI was obtained as the square of height in meter divided by body weight in kg according to the formula: BMI-height (m^2)/weight (kg) and expressed kg/m^2. Anthropometric assessment of nutritional status: classification of nutritional status was made according to public health criteria recommended by the World Health Organization expert committee.[19] To evaluate the conditions of undernutrition and overnutrition, five outcome variables were considered; stunted, thin or wasted, coexistence of both, or thin and stunted,

overweight, and obese. These conditions were assessed from the WHO recommended z scores of two nutritional indices. The z scores of the Height-for-age index were used to assess stunting while the z scores of the BMI-for-Age index were used to assess the other three categories, i.e., thinness, overweight, and obesity.

Calculation of Z scores

The HAZ z score for an individual subject of the study population belonging to a particular age was calculated as: (measured height-median height of the reference population of the same age)/SD of the ref population. For calculating the z- scores of BMIAZ, the body mass index values of the study population were converted to exact z scores from the L, M, and S values of the reference charts of the corresponding age groups, using the following formula:

$$Z \text{ score} = ([BMI \text{ score of study population } /M]^L - 1) / LS$$

Where L, M and S are Box-Cox power, median, and coefficient of variation of the corresponding age of the reference population respectively.[20] Cut off values of Z scores for defining malnutrition: categories of malnutrition were defined according to the cut-off values of z scores presented in the WHO growth reference data for 5-19 years old adolescents.[2] The following cut-offs for the Z-score of HAZ was used to define different categories of undernutrition as per HAZ: stunted= z score <-2SD to ≤-3SD, severely stunted= z score <-3SD. The following z scores cut-off values of BMIAZ were used to define the different conditions of under and overnutrition: wasted =z score is <-2SD to ≤-3SD, severely wasted=z

score = <-3SD, overweight = z score >1SD, obese= z score is >2SD. A subject was considered normal if the z scores for both HAZ and BMIAZ were found to be >-2SD.

RESULTS

The mean height at 15, 16, and 17 years was 167.2±7.01 cm, 168.3±6.13, and 168.7±5.84 cm respectively which shows an increasing trend with age. At 15 and 16 years age group government boys were slightly taller than the private boys, however, the mean differences in the height were not found to be statistically significant. However at 17 years of age, the private boys appeared to be statistically significantly taller (mean height 170.8±5.24 cm) as compared to the government boys (mean height 166.4±5.69 cm, t=3.30, p=0.002) (Table 1). The mean weight showed an increasing trend with age. The mean height at 15, 16, and 17 years was 52.4±1.0 kg, 53.6±8.8 kg, and 56.1±7.0 kg respectively. At 15 and 16 years, the boys from government school were heavier than the private school boys and the mean difference appeared to be statistically significant. At 17 years of age, the private boys appeared to be slightly heavier than the government boys, but this difference was not statistically significant (Table 2). The mean BMI at 15, 16, and 17 years was 18.7±3.21, 18.9±2.69, and 19.7±1.95 respectively which also showed an increasing pattern with age. At all age groups, there was no statistically significant effect for school category despite the government schoolboys have higher BMI as compared to the private boys (Table 3).

Table 1: Descriptive summary of height.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	167.8	6.69	168.0	1.20	0.973	0.33
	Pvt. (71)	166.6	7.27	167.0			
	Total (131)	167.2	7.01	168.0			
16	Govt. (43)	168.8	6.69	169.0	0.90	0.725	0.470
	Pvt. (57)	167.9	5.70	168.0			
	Total (100)	168.3	6.13	168.7			
17	Govt. (32)	166.4	5.69	165.0	-4.40	3.30	0.002
	Pvt. (35)	170.8	5.24	170.0			
	Total (67)	168.7	5.84	167.0			
Total	Govt. (136)	167.8	6.48	168.0	-0.20	0.265	0.791
	Pvt. (163)	168.0	6.51	169.0			
	Total (298)	167.9	6.49	168.0			

The overall prevalence of stunting was found to be 5.7%. In different age groups, the percentage of stunted boys varied between 5% in 16 years, to 6.1% in 15 years. At 17 years the stunting rate was 6%. The Pearson's chi-square test showed that and there was no significant level of association between the prevalence of stunting with the

age group's age (χ^2 square=0.140(2), p= 0.932). None of the boys were found to be severely stunted (Table 4). The overall prevalence of thinness was found to be 15.8%. The highest prevalence of thinness (19.8%) was found among the 15 years old boys followed prevalence of (16%) at the age of 16 years and 7.5% at 17 years of age.

In different age groups, none of the boys were severely wasted. The overall prevalence of overweight and obesity was 5.4% and 1.7% respectively. The percentage of overweight boys varied between 3% at 17 years to 6.9% at 15 years of age.

Table 2: Descriptive summary of weight among boys of Government and private schools.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	53.7	1.0	51.5	2.30	13.12	0.000
	Pvt. (71)	51.4	1.0	50.0			
	Total (131)	52.4	1.0	51.0			
16	Govt. (43)	55.1	1.02	53.0	2.60	2.25	0.03
	Pvt. (57)	52.5	7.5	51.0			
	Total (100)	53.6	8.8	52.0			
17	Govt. (32)	55.2	8.29	52.0	-1.70	0.99	0.33
	Pvt. (35)	56.9	5.63	55.5			
	Total (67)	56.1	7.0	55.0			
Total	Govt. (136)	54.5	9.71	52.0	1.60	1.51	0.133
	Pvt. (163)	52.9	8.65	52.0			
	Total (298)	53.6	9.2	52.0			

Table 3: Descriptive summary of BMI among boys of government and private schools.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	19.0	3.36	18.3	0.60	1.06	0.29
	Pvt. (71)	18.4	3.07	18.0			
	Total (131)	18.7	3.21	18.1			
16	Govt. (43)	19.3	3.11	18.1	0.70	0.02	0.98
	Pvt. (57)	18.6	2.32	18.1			
	Total (100)	18.9	2.69	18.1			
17	Govt. (32)	19.9	2.21	19.2	0.40	0.84	0.41
	Pvt. (35)	19.5	1.68	19.3			
	Total (67)	19.7	1.95	19.3			
Total	Govt. (136)	19.3	3.04	18.6	0.60	1.85	0.07
	Pvt. (163)	18.7	2.58	18.5			
	Total (298)	19.0	2.81	18.5			

Table 4: Prevalence of stunting among Himachali boys; N (%).

Age group (years) (N)	Normal	Stunting (<-2SD)	Severe. stunting (<-3SD)	X^2 (P value)
15 (131)	123 (93.9)	8 (6.1)	0 (0)	0.140 (0.932)
16 (100)	95 (95)	5 (5)	0 (0)	
17 (67)	63 (94)	4 (6)	0 (0)	
Total	281 (94.3)	17 (5.7)	0 (0)	

The prevalence of obesity was 3.1% at 15 years and 1% at 16 years. None of the boys at the age of 17 years were found to be obese. The Pearson's Chi-Square test showed that there was no significant level of association between the prevalence of different categories of malnutrition with the age groups (Chi-Square=10.633(6), p=0.100) (Table 5). Five different categories of malnutrition were identified. Wasting or thinness was much higher as compared to other categories of malnutrition. The coexistence of both stunted and wasted children was found only at the age group of 15 years (Figure 1).
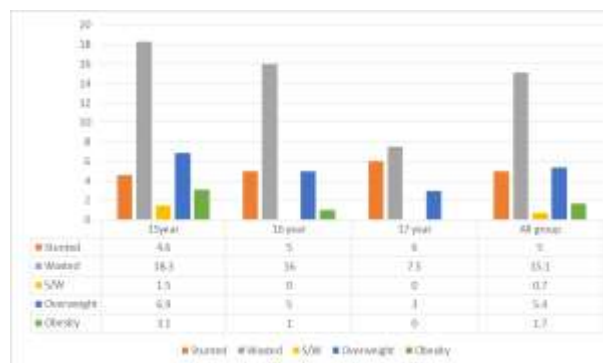

Figure 1: Representation of different categories of malnutrition.

Table 5: Prevalence of thinness among Himachali boys; N (%).

Age group (years) (N)	Normal	Thinness (<-2SD)	Severe thinness (<-3SD)	Overweight	Obesity	X^2 (P value)
15 (131)	92 (70.2)	26 (19.8)	0	9 (6.9)	4 (3.1)	10.633 (0.100)
16 (100)	78 (78)	16 (16)	0	5 (5)	1 (1)	
17 (67)	60 (89.6)	5 (7.5)	0	2 (3)	0 (0)	
Total	230 (77.2)	47 (15.8)	0	16 (5.4)	5 (1.7)	

DISCUSSION

Assessment of height and weight and converting them into nutritional indices is a standard procedure worldwide for the assessment of the nutritional profile of a population. The present study reported the nutritional profile of the Himachali adolescent boys within the age group of 15-17 years of age.

Height of the Himachali boys

The height of the Himachali boys examined in the present study varied between 167.2 cm at 15 years to 168.8 cm at 17 years. These boys were found to be taller than the Shabar tribal adolescents of Orissa; mean height 155.9 cm at 15 years, 156.5cm at 16 years, and 157.7 cm at 17 years of age, but comparable with the heights reported for the north Indian school children; mean height 165.9, 169.3, and 172 cm at 15, 16, and 17 years of age respectively.[21,22] On a comparative account, it appeared that the 15 years old Himachali boys were slightly taller as compared to the north Indian boys reported in this study. However, the 16 and 17 years old north Indian boys appeared to be taller than the Himachali boys by 1 cm and 3.2 cm respectively.

In a more recent study, much lower heights (155.5 cm at 15 years, 157.5 cm at 16 years, and 158.6 cm at 17 years) were reported for rural adolescent children from West Bengal[8] as compared to Himachali boys. For the age group of 15 years, the mean reported heights available in different studies varied from 153.6 cm for urban adolescent boys of south Gujrat and 161.2 cm for urban children of Nagaland Himachali boys were taller as compared to these populations. However, the mean height (168.4 cm) of 15 years old children from Kharad, Maharastra, was higher than the present 15 years old Himachali boys.[6,23,24]

Weight of Himachali boys

Like the height, the mean weight of the present Himachali boys was higher than the weights reported for the Shabar tribal adolescents of Orissa, for all the age groups considered; 42.5 kg at 15 years, 44.2 kg at 16 years, and 45.7 kg at 17 years. Himachali boys were also found to be heavier than the rural adolescent boys from West Bengal with a mean weight of 42.8 kg at 15 years, 44.2 kg at 16 years, and 47.2 kg at 17 years.[8,21] In comparison to the North Indian school children, the mean weights of Himachali boys were found to be lower at all age groups.[21,22] The mean weight of Himachali boys at 15 years was 52.4 kg. Almost similar weight (52.2 kg) was obtained for 15-year-old urban boys from Karad Maharastra.[24] Two other studies reported a mean weight of 36.2 kg for the urban adolescents of South Gujrat and 48.7 kg for the Naga children which were much lower as compared to the present Himachali boys.[6,23]

Comparison of stunting

The prevalence of stunting of the Himachali boys in three different age groups was almost similar and varied between 5-6%. This is much lower as compared to the stunting reported among the rural adolescents from nine different Indian states.[25] In this study, the stunting rates were 48.9%, 51.8%, and 59.7% in the age groups of 15, 16, and 17 years respectively. Higher rates of stunting were also reported among the rural adolescent boys of U.P (27.4%) rural adolescent boys of West Bengal (59.5%)[8] and adolescent boys of UP and Bihar (27.3%) of similar age group.[10,13]

Comparison of thinness

The rate of thinness in the present Himachali boys showed a decreasing trend from 15 to 17 years. Varying from 19.8% to 7.5% respectively, with an overall prevalence rate of 15.8%. Some studies also reported a similar decreasing trend in the age group of 15-17 years.[8,21] The rate of thinness among the present Himachali boys (15.8%) was lower as compared to the urban Bengali adolescent boys, from urban and rural areas with a prevalence rate of 20.6%, and 38% respectively.[5,8] Chakraborty and Bharti reported a prevalence of thinness that varied between 33.3%-25% between 16-17 years with the lowest prevalence of 25% observed in 17 years of age. These values were also higher as compared to the present study.[6,21]

An overall prevalence rate of 25.7% was reported among the Naga children,[6] which was also higher than the rate obtained in the present study. In contrast to the above mentioned higher prevalence rates of thinness reported from different Indian states, the rate of the thinness of the boys from Mandi district of Himachal Pradesh, almost matches with previous findings that reported 18.2% thinness among the 15 years old boys from Naggar area of Kullu district of Himachal Pradesh.[16]

Comparison of overweight and obesity

In the present study obesity and overweight, both categories of over nutrition were found among the Himachali boys. The overall prevalence of overweight and obesity was found to be 5.4% and 1.7% respectively. The findings on the overweight were lower in all the age groups in comparison to the rate of overweight reported among Bengali urban adolescents.[5] The prevalence of overweight and obesity among present Himachali boys was 3% -6.9% which was lower as compared to the overweight and obesity rate among urban Bengali boys.[5] However, the prevalence of overweight was almost similar to that of the rural Bengali boys.[8] The present rate of overweight among the 15 years old boys was higher as compared to the two previous reports of overweight among Naga children and Himachali boys from Naggar district of Kullu.[6,16]

CONCLUSION

Himachali boys appeared to be taller than most of the Indian population of boys of similar age groups. Prevalence of the different categories of overnutrition and undernutrition were also lower as compared to that obtained for other Indian studies on adolescent boys. The existence of overweight and obese individuals points towards the double burden of malnutrition.

ACKNOWLEDGEMENTS

REFERENCES

1. Cogill B. Anthropometric indicators measurement guide 2003. Available at https://www.fhi360.org/. Accessed on 27 April, 2020.
2. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660-7.
3. de Onis M, Dasgupta P, Saha S, Sengupta D, Blossner M. The National Center for Health Statistics reference and the growth of Indian adolescent boys. Am J Clin Nutr. 2001;74(2):248-53.
4. de Onis M, Blossner M. WHO global data base on child growth and malnutrition. programme of nutrition. Available at: https://www.who.int/teams/nutrition-and-food-safety/databases/nutgrowthdb. Accessed on 27 April, 2020.
5. Besai S, Khongsdier R, Bose K, Mahalanabis D. Double burden of malnutrition among urban Bengalee adolescent boys in Midnapore, West Bengal, India. Nat Prec 2012;15:25-9.
6. Longkumar T. Physical growth and nutritional status among Ao Naga children of Nagaland, Northeast India. J Anthropol. 2013;2013:40-6.
7. Patel N, Gunjana G, Patel S, Thanvi R, Sathvara P, Joshi R. Nutrition and health status of school children in urban area of Ahmedabad, India: comparison with Indian Council of Medical Research and body mass index standards. J Nat Sc Biol Med. 2015;6(2):372-7.
8. Pal A, Pari AK, Sinha A, Dhara PC. Prevalence of undernutrition and associated factors: A cross-sectional study among rural adolescents in West Bengal, India. Int J Pediatr Adolesc Med. 2017;4:9-18.
9. Dey I, Biswas R, Ray K, Bhattacherjee S, Chakraborty M, Pal PP. Nutritional status of school going adolescents in a rural block of Darjeeling, West Bengal, India. Health. 2011;2(3):75-7.
10. Nguyen PH, Scott S, Neupane S, Tran LM, Menon P. Social, biological, and programmatic factors linking adolescent pregnancy and early childhood undernutrition: a path analysis of India's 2016 National Family and Health Survey. Lancet Child Adolesc Health. 2019 ;3(7):463-473.
11. Shivaprakash NC, Joseph RB. Nutritional status of rural school going children (6-12 years) of Mandya District, Karnataka. Int J Sci Study. 2014;2(2):39-43.
12. Shashank KJ, Chethan TK. Nutritional status of school going children between the age group of 6-12 yrs in rural area of Bijpaur district. Ntl J Commu Med. 2016;7(5):409-12.
13. Kumar P, Srivastava S, Chauhan S, Patel R, Marbaniang SP, Dhillon P. Associated factors and socio-economic inequality in the prevalence of thinness and stunting among adolescent boys and girls in Uttar Pradesh and Bihar, India. PLoS One. 2021;16(2): e0247526.
14. Kanjilal B, Mazumdar GP, Mukherjee M, Rahman MH. Nutritional status of children in India: household socio-economic condition as the contextual determinant. Int J Equity Health. 2010;9:19.
15. Talwar I, Sharma K, Kapur S. Growth trends in body, fat, circumferential and physiological traits during adolescence among Rajput females of Theog, Shimla District (Himachal Pradesh), India. Ann Hum Biol. 2010;37(4):536-53.
16. Airi P, Edwin CJ. Anthropometric Assessment of Nutritional Status of Adolescent Naggar Boys and Girls of Himachal Pradesh. South Asian Anthropol. 2011;11:67-75.
17. Biswas R, Saini N & Kaur J. Anthropometric assessment of growth and nutritional status of school going boys of Himachal Pradesh. Int J Sci Res. 2014;3(11):72-5.

18. Singh H, Gupta A, Sachdeva A, Barall S, Kumar D, Singh S. Nutritional status of 1-5 years children in a hilly tribal district of North India. Int J Contemp Med Res. 2016;3(11):3286-8.
19. World Health Organization. Physical status: the use and interpretation of anthropometry. World Health Organ Tech Rep Ser.1995;854:1-452.
20. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000; 320(7244):1240-3.
21. Chakrabarty S, Bharati P. Physical growth and nutritional status of the shabar tribal adolescents of Orissa, India: a cross-sectional study. Mal J Nutr .2008;14(1):101-12.
22. Marwaha RK , Tandon N, Ganie MA, Kanwar R, Shivaprasad C, Sabharwal A et al. Nationwide reference data for height, weight and body mass index of Indian schoolchildren. Natl Med J India. 2011;24(5):45-9.
23. Thakur HG, Kumar P, Desai VK, Srivastava RK. Physical growth standards for urban adolescents (10-15 years) from South Gujrat. Indian J Commu Med. 2000;25(2):86- 92.
24. Patil SS, Patil SR, Durgawale PM, Kakade SV, Kumar A. Study of physical growth standards of adolescents (10-15 years) from Karad, Maharashtra. Int J Collab Res Intern Med Public Health. 2013;5(1):10-18.
25. Venkaiah K, Damayanti K, Nayak MU, Vijayaraghavan K. Diet and nutritional status of rural adolescents in India. Eur J Clin Nutr. 2002;56:1119-25.

Cite this article as: Pathania NS, Biswas R. Assessment of nutritional status of adolescent school going boys of Himachal Pradesh. Int J Community Med Public Health 2021;8:4960-6.

Type of article: Original article

"Anthropometric Study Of Nutritional Status Of Adolescent Girls Of Himachal Pradesh"

1.   Pathania S Neetu. (M. Phil).

Ph.D. Scholar, Department of Chemistry, Pacific Academy of Higher Education and Research (PAHER), Pacific Hills, Pratap Nagar Extension, Debari, Udaipur – 313024, Rajasthan, India

2.   Choudhary Varsha (Ph. D).

Department of Chemistry, Pacific Academy of Higher Education and Research (PAHER), Pacific Hills, Pratap Nagar Extension, Debari, Udaipur – 313024, Rajasthan, India

3.   Biswas Rajib (Ph. D) – Corresponding Author

Department of Physiology,
Himachal Dental College, Sundernagar, Himachal Pradesh – 175002, India.
Phone numbers – 9805022394
E-mail address – ergoraj@gmail.com

Running title: "Nutritional status of adolesent Himachali girls".

Contribution Details (to be ticked marked as applicable):

	Contributor 1	Contributor 2	Contributor 3	Contributor 4
Concepts			√	
Design			√	
Definition of intellectual content	√	√	√	
Literature search	√		√	
Clinical studies				
Experimental studies				
Data acquisition	√	√	√	
Data analysis	√		√	
Statistical analysis			√	
Manuscript preparation	√		√	
Manuscript editing	√	√	√	
Manuscript review	√	√	√	
Guarantor			√	Abstract Page

Title of the article: Anthropometric study of nutritional status of adolescent girls of Himachal Pradesh

Abstract:

Background:

Adolescents represent a very significant part of the community as they represent the future generation. Proper nutrition of adolescent girls is of immense public health importance for positive pregnancy outcomes to break the intergenerational malnutritional cycle. Very few reports are available on the anthropometric growth and nutritional standard of the Himachali adolescent girls.

Aims:

The present study aims to assess the prevalence of malnutrition of Himachali adolescent girls from their anthropometric growth standards.

Methods and Material:

A cross sectional study was conducted among school going girls within the age group of 10-17 years selected from non- hilly regions of Mandi district of the Himachal Pradesh. Height, weight and age at the time of survey were determined. Z-score for height for age and BMI for age was calculated and compared with WHO growth reference standard to detect stunting, wasting, overweight and obesity.

Results:

There is a progressive increase in the mean height, weight and BMI of girls across all the age groups. The maximum gain of 6 cm in height and 5.6 kg in weight was recorded between 11-12 years. Prevalence of thinness, stunting and overweight was 17.6%, 9% and 4.3% respectively.

Conclusions:

As compared to the 50th percentile Indian growth reference standard the mean height of Himachali girls at all age groups appear to be slightly lower except for 10 and 13 years of age but the mean weights of all age groups appeared to be lower. Thinness appeared to be most prevalent form of malnutrition

Key-words: Physical growth, nutrition, height, weight, stunting, wasting, adolescent girls, Himachal Pradesh.

Introduction:

Anthropometric measurements include somatic measurements. Height and weight are the two primary somatic measurements that reflect physical growth of an individual. The normal physical pattern of growth is majorly determined by the genetic makeup of an individual and continues with a standard level of gain in both height and weight with chronological age. Human growth occurs during infancy, childhood and adolescence. In each phase, the growth pattern depends on nutrition. Poor nutrition hinders optimal growth and results in growth deficiencies. Growth deficiency is the inability to gain normal level of height at a particular age, or the inability to gain a normal level of weight for a particular height. To determine the growth pattern and growth deficiencies, the height and weight data are transformed into suitable indices in relation to age and sex of the individual. These indices serve as important proxy measures of nutritional standard and detect malnutrition that evolves from nutritional imbalance or deficiencies. [1]

The adolescent period is considered as a period of rapid physical development with attainment of secondary sexual characteristics. Due to high nutritional demand required for rapid growth this period is also considered as the most vulnerable period from the view point of nutrition. A wide range of studies have indicated that nutritional inadequacies in adolescence can retard growth and can make one susceptible to various diseases in the adult life. [2, 3]

The domain of adolescent's growth and nutrition is immensely important as the adolescents are the future workforce and bearers of next generation. Even more importance is placed on the nutritional standards of the adolescent girls because they represent future mothers and therefore. contribute significantly to the nutritional status of the community. Optimal nutrition among adolescent girls brings positive pregnancy outcome and break the intergenerational malnutrition cycle. [4-5]

Reports on the physical growth and nutritional status of Himachali adolescent girls are scanty. In this backdrop this cross-sectional study was designed to evaluate the nutritional status of adolescent girls from non-hilly region of Himachal Pradesh within the age group of 10-17 years.

Materials and Methods:

Study Design

A cross sectional study was conducted among a sample of 749 Himachali girls aged 10-17 years. Data were collected from four schools belonging to the Mandi Sadar, Balh, and Sundernagar subdivisions of the Mandi district of Himachal Pradesh. The data for study was collected between the month of May 2018 to August 2018.

Sample Size Calculation

For estimating the sample size, the study adopted a conservative approach to estimate the prevalence of malnutritional conditions in the target population and a 50 % prevalence rate was selected. Sample size was estimated by the following formula:

$$n = Z^2 P(1-P) / d^2$$

Research Paper © 2012 IJFANS. All Rights Reserved.

Where n is the sample size, Z is the statistic corresponding to the level of confidence, P is expected prevalence, and d is precision (corresponding to effect size).

In the present study, the sample size was estimated from the following values:

z- The Z score at 95% confidence interval = 1.96
p - the assumed prevalence = 50 %
1- p = 50 %
d = precision level or margin of error = 5%
Accordingly, the total sample is calculated = (1.96*1.96*0.5*0.5) X 100
                                    (0.5*0.5)
                                    = 385

However, presuming an attrition rate of 20%, the number of students that this study will cover will be approximately 385 + (20 % of 385) = 385 + 77 = 462. The minimum number was rounded to 470. However, in practice the study covered a much large number of samples, A total of 749 girls were selected for the study.

Ethical approval and consent
The ethical approval for this survey was obtained from the Institutional Ethics Committee (IEC) of Himachal Dental College, Sundernagar, District Mandi, Himachal Pradesh, IEC number 2017-24, dated:19.12.2017.

Exclusion and inclusion criteria
Prior to the study, the students were explained about the purpose of the study and the extent of their involvement in presence of the respective class teachers. The same was also conveyed to their parents through the class teachers. The students who consented to participate in the study, through their parents, according to the design of the experiment were included. The children suffering from any type of chronic disease or those who reported any illness during the last one month before the study date were excluded from the study.

Physical Measurement
Age was obtained from the Date of Birth (DOB) as mentioned in the school register. Height was measured with an anthropometric rod with shoes removed and head aligning in the Frankfurt plane. Readings were taken to the nearest 1 cm. Weight was measured in kg by using a bathroom room-scale with school uniform and shoes removed, to the nearest 500 grams. Body Mass Index (BMI was obtained as the square of height in meter divided by body weight in kg according to the formula:
BMI = height (m^2) / weight (kg) and expressed kg/m^2.

Calculation of Z scores
The height for age (HAZ) z score was obtained for all subjects. This was calculated as the difference of measured height and the median height of the WHO reference population of the same age, divided by the SD of the reference population.
The Z scores for BMI for age (BMIAZ) was calculated from BMI vales of the subjects using the L, M, and S values of the WHO reference population of the corresponding age groups. [6]
Assessment of Nutritional Status
For analytic purposes, five different malnutritional conditions, viz., 1) stunted 2) thinness 3) coexistence of both stunted and thinness, 4) overweight, and 5) obesity were considered.

Categories of malnutrition were defined according to the cut-off values of the following z scores recommended by the WHO, according to the growth reference data for 5 – 19 years old adolescents. [7-8]

- Stunted: Height-for-Age Z score < - 2SD to ≤ - 3SD,
- Severely stunted: Height-for-Age Z score < - 3SD
- Wasted: BMI-for-Age Z score < - 2SD to ≤ - 3SD,
- Severely wasted: BMI-for-Age Z score = < - 3SD,
- Overweight: BMI-for-Age Z score > 1 SD
- Obese: BMI-for-Age Z score is > 2 SD

A subject was considered normal if the z scores for both HAZ and BMIAZ were found to be > -2SD.

Result

Height and Weight of the subjects

The mean height, weight and BMI of the subjects are presented in table 1. The data showed that there is a progressive increase in the mean height, weight and BMI of girls with chronological age. Mean heights at 10 and 17 years were 139.4 cm 156.6 cm respectively, depicting a total gain of 17.2 cm between these years. Similarly, the mean weight increases from 29.3 kg at 10 years to 46.5 kg at 17 years. The total increase in mean weight was 17.2 kg.

Maximum gain in height and weight was obtained from 11 to 13 years. For height the gain is 6 cm between 11-12 years and 5.3 cm between 12 to 13 years. For weight, maximum gain was 5.6 kg between 11-12 years 3.6 kg between 11-12 years.

As compared to the 50th percentile height of the Indian reference population,[9] the mean height of the Himachali girls at all groups appeared to be slightly lower except for 10 and 13 years of age. In contrast, the mean weight at all age groups appeared to be lower than the 50th percentile weight standards. (Figure 1 & 2).

Prevalence of Malnutrition

Table 2 summarizes the prevalence of stunting across all age groups. Stunting was maximum at age group of 11 (N = 19, 17.9 %) and minimum at 10 years of age (N = 2, 2,5%). No age-related trend was obtained in the prevalence rate of stunting. Severely stunted girls were found only in the age group of 12 (N = 3, 2,7%) and 15 (1, 1.1%) years. Overall prevalence of stunting was 9 %.

Prevalence of thinness across all age group was higher than stunting. Maximum thinness was found among 10- and 11-years group, while minimum thinness was obtained at 12, 14 and 15 years. (Table 3)

Prevalence of overnutrition was minimum as compared to stunting and thinness. Overweight and obese girls were more in 11, 12 and 16 years, highest prevalence of overweight and obesity were obtained at 16 and 12 years respectively (Table 4).

Prevalence of stunting, wasting, and combined overnutrition were found to be higher in the early adolescent girls between 10 – 14 years (N = 460), as compared to the late adolescent group, aged between 15 – 17 years (N = 289). The proportion of the subjects who were stunted, thin and in the overnutrition category did not vary significantly with respect to the

adolescent category, chi square (2, N= 232) = 1.511, p = 0.47. The prevalence of different categories of malnutrition among the early and late adolescent groups is presented in figure 3.

Discussion:

Height and Weight of Himachali Girls as compared to other Indian studies

Attempt has been made to compare the height and weight of the present Himachali girls with other Indian pollution of adolescent girls of similar age group as reported in some earlier studies.

The mean height of Himachali girls was 150.7 cm. Higher mean heights of 152 cm and 152.3 cm has been reported for Indian school children [10] and Rajput females from Shimla district of Himachal Pradesh [11] respectively.

Himachali girls were found to be taller by 7 to 8 cm as compared to the mean height of Indian rural adolescents [12], Shabar tribal adolescents' girls from Odissa [13], and rural adolescent girls from West Bengal[14] which was reported to be 143.1 cm, 142.2 cm, and 143.5 cm respectively for the same age group. However, similar height of 150 cm was reported for the north Indian girls. [15]

The mean weight of Himachali girls was 40.1 kg. A higher group mean weight 45.6 kg and 41.4 kg was reported for Indian school children [10] and north Indian girls [15] respectively. While lower mean weight was reported for Rajput females from Shimla district of Himachal Pradesh [11], Indian rural adolescents [12], Shabar tribal adolescents' girls from Odissa [13], rural adolescent girls from West Bengal [14] and which were 39.9 kg, 33.7 kg, 34.2 kg and 34.1 kg and respectively.

Malnutrition in Himachali girls as compared to other Indian studies

The present Himachali girls represents urban and peri urban population. The prevalence rate of different categories of malnutrition of this girls can be compared with the prevalence rates of malnutrition reported for adolescent girls from different parts of India covering both rural and urban areas.

Comparison of the prevalence of stunting

The overall rate of stunting appeared to be 9 %. This is lower than the stunting rates reported for urban adolescent girls of Maharashtra [16], Uttar Pradesh [17], Assam [18]and Uttar Pradesh and Bihar [19] but higher as compared to the urban adolescent girls from Bangalore [20].

Compared to different rural populations, the present rate of stunting was higher as compared to reports from Karnataka [21] , and Medinipur [22] and Jalpaiguri districts of West Bengal [23], but much lower as compared to the reports available from Bijapur [24] and Mandya [25] districts of Karnataka, and also from Bareilly [26] Uttar Pradesh Jammu [27] and Birbhum and Medinipur districts of west Bengal [14] and rural adolescent of Uttar Pradesh and Bihar[19] The comparative prevalence of stunting is depicted in figure 6.

Comparison of the prevalence of thinness

The overall rate of thinness appeared to be 17.6 %. This is lower as compared to almost all the studies conducted in different rural adolescent girls from West Bengal [28,14], Karnataka [21,24], Uttar Pradesh [26,29] Tamil Nadu [30] and Himachal Pradesh [31], but higher as compared to the reports from Bihar and UP [19].

Research Paper © 2012 IJFANS. All Rights Reserved.

The wasting rates of the Himachali girls are much lower as compared to the wasting rates reported for urban populations from Varanasi [32], Mysore [33], Assam [18] and Uttar Pradesh [29]. The comparative representation of wasting rate is presented in figure 7.

Comparison of the prevalence of overweight

In comparison to other reports of overnutrition on Urban population [32,34,35] the prevalence rate of overweight of Himachali girls (3 .3 %) is slightly higher, but lower as compared to urban and rural girls from Uttar Pradesh [29]. In comparison to other reports of overweight among rural adolescent girls [14,28,31], overweight among Himachali girls was obtained to be higher. (figure 8).

CONCLUSION

This is one of the first large scale study conducted on urban and peri urban adolescent Himachali girls from non-hilly regions of the state, which reported the height, weight and the prevalence of different categories of malnutrition among the Himachali girls

In comparison to the height and weight of Indian growth reference at different age groups from 10 – 17 years, the mean heights of Himachali girls in different age groups appeared to be almost similar, but the mean weights were found to be lower.

Across all age groups, thinness appeared to be most prevalent form of malnutrition, followed by stunting and overnutrition. No age-related trend was observed for malnutrition categories. The prevalence rates of different malnutrition categories when compared between the early and late adolescent groups, appeared to be statistically insignificant.

The prevalence of stunting and thinness obtained for the Himachali girls were found to be lower as compared to the most of the reports available for different population of Indian adolescent girls.

Acknowledgement:

Financial Support and sponsorship

Conflicts of Interest

There are no conflicts of interest.

References:

1. Eaton–Evans. Anthropometry. In: Caballerrob, Allen L, Prentice A, editors. Encyclopedia of Human Nutrition. 2nd ed. Oxford: Elsevier; 2005. pp.311-18.
2. Storey KE, Hanning RM, Lambraki IA, Driezen P, Fraser SN, McCargar LJ. Determinants of diet quality among Canadian adolescents. Can J Diet Prac Res. 2009;70(2):58-65. DOI: 10.3148/70.2.2009.58.
3. Spear BA. Adolescent growth and development. J Am Diet Assoc. 2002; 102: S23–9.

4. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet. 2013;382(9890):427-51. doi: 10.1016/S0140-6736(13)60937-X.

5. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? The lancet. 2013;382(9890): 452-77.

6. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320 (7244):1240-3. doi: 10.1136/bmj.320.7244.1240

7. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007; 85(9):660-7.

8. de Onis M, Lobstein T. Defining obesity risk status in the general childhood population: which cut-offs should we use? Int J Pediatr Obes. 2010; 5(6):458-60.

9. Khadilkar V, Khadilkar AV, Kajale N. Indian growth references from 0-18-year-old children and adolescents - A comparison of two methods. Indian J Endocr Metab. 2019; 23:635-44.

10. Marwaha RK, Tandon N, Ganie MA, Kanwar R, Shivaprasad C, Sabharwal A, et al. Nationwide reference data for height, weight and body mass index of Indian schoolchildren. Natl Med J India. 2011; 24(5).

11. Talwar I, Sharma K, Kapur S. Growth trend in body, fat, circumferential and physiological traits during adolescence among Rajput females of Theog, Shimla District (Himachal Pradesh), India. Annals of Hum Biol. 2010; 37(4): 536- 53.

12. Venkaiah K, Damayanti K, Nayak MU, Vijayaraghavan K. Diet and nutritional status of rural adolescents in India. Eur J Clin Nutr. 2002; 56:1119- 25.

13. Chakrabarty S, Bharati P. Physical growth and nutritional status of the Shabar tribal adolescents of Orissa, India: a cross-sectional study. Mal J Nutr. 2008; 14(1) :101-12.

14. Pal A, Pari AK, Sinha A, Dhara PC. Prevalence of undernutrition and associated factors: A cross-sectional study among rural adolescents in West Bengal, India. Int J Pediatr Adolesc Med. 2017; 4: 9-18.

15. Agarwal DK, Agarwal KN, Upadhyay SK, Mittal R, Prakash R, Rai S. Physical and sexual growth pattern of affluent Indian children from 5 to 18 years of age. Indian Pediatr. 1992; 29(10):1203-82. PMID: 1286886.

16. Dambhare, DG, Bharambe MS, Mehendale AM, Garg BS. Nutritional status and morbidity among school going adolescents in Wardha, a peri-urban area. Online J Health Allied Sci. 2010; 9(2): 3. http://www.ojhas.org/issue34/2010-2-3.htm

17. Srivastava A, Mahmood SE., Srivastava PM, Shrotriya VP, Kumare B. Nutritional status of school-age children - A scenario of urban slums in India. Arch Public Health. 2012; 70:8. doi:10.1186/0778-7367-70-8.

18. Konwar P, Vyas N, Hossain SS, Gore MN, Choudhury M. Nutritional status of adolescent girls belonging to the tea garden estates of Sivasagar district, Assam, India. Indian J Community Med. 2019; 44:238-42. doi: 10.4103/ijcm.IJCM_357_18

19. Kumar P, Srivastava S, Chauhan S, Patel R, Marbaniang SP, Dhillon P. Associated factors and socio-economic inequality in the prevalence of thinness and stunting among adolescent boys and girls in Uttar Pradesh and Bihar, India. PLoS One. 2021; 16(2): e0247526. doi.org/10.1371/journal.pone.0247526

20. Dhoundiyal M, Prithviraj R. Physical growth pattern of school going urban adolescent girls in Bangalore city. Int J Community Med Public Health. 2017; 4: 2090-3.

21. Shivaramakrishna HR, Deepa AV, Sarithareddy M. Nutritional status of adolescent girls in rural area of Kolar district -A Cross-Sectional Study. Al Ameen J Med Sci. 2011; 4 (3): 243 - 46.

22. Maiti S, Chattterjee K, Ali KM, Ghosh D, Paul S. Assessment of nutritional status of early adolescent school girls in Dantan-II block, Paschim Medinipur district, West Bengal. Natl. J. Community Med. 2011; 2(1):14-18.

23. Manna PK, De Debasis, Bera TK, Chatterjee K, Ghosh D. Anthropometric assessment of physical growth and nutritional status among school children of North Bengal. Anthropologist. 2011; 13(4): 299-305.

24. Shashank KJ, Chethan TK. Nutritional status of school going children between the age group of 6-12 yrs in rural area of Bijpaur district. Natl J Community Med. 2016; 7(5):409-12.

25. Shivaprakash NC, Joseph RB. Nutritional Status of Rural School-Going Children (6-12 Years) of Mandya District, Karnataka. Int J Sci Study. 2014; 2(2): 39-43.

26. Singh JP, Kariwal P, Gupta SB, Singh AK, Imtiaz D. Assessment of nutritional status among adolescents: a hospital based cross sectional study. Int J Res Med Sci. 2014; 2:620-4. doi: 10.5455/2320-6012.ijrms20140547.

27. Katoch OR, Sharma A. Socioeconomic factors, living conditions and child undernutrition among school going children in rural areas of district Doda, Jammu & Kashmir, India: A preliminary study. Indian J Nutri. 2016; 3 (1): 123.

28. Dey I, Biswas R, Ray K, Bhattacherjee S, Chakraborty M, Pal PP. Nutritional status of school going adolescents in a rural block of Darjeeling, West Bengal, India. The Health. 2011;2(3):75-7.

29. Ahmad S, Shukla NK, Singh JV, Shukla R, Shukla M. Double burden of malnutrition among school-going adolescent girls in North India: A cross-sectional study. J Family Med Prim Care. 2018; 7(6):1417-1424. doi: 10.4103/jfmpc.jfmpc_185_18.

30. Parimalavalli R, Sangeetha M. Anthropometric Measurements and nutrient intake of adolescent girls. Anthropologist. 2011;13(2): 111-15.

31. Airi P, Edwin CJ. Anthropometric assessment of nutritional status of adolescent Naggar boys and girls of Himachal Pradesh. South Asian Anthropologist 2011; 11(1): 67-75.

32. Rani D, Singh JK, Srivastava M, Verma P, Srivastava D, Singh S. Assessment of nutritional status of teenage adolescent girls in urban slum of Varanasi. Int J Cur Res Rev. 2018; 10(20): 6-10.

33. Chandrashekarappa SM, Ramakrishnaiah NMM, Manjunath R. Nutritional status in adolescent girls: Attempt to determine its prevalence and its association with

sociodemographic variables. Fam Med Community Health. 2018;6(4):184–190. www.fmch-journal.org doi 10.15212/FMCH.2017.0122.

34. Longkumar T. Physical growth and nutritional status among Ao Naga children of Nagaland, Northeast India. Journal of Anthropology 2013; 1-6. Article ID 291239, 6 pages http://dx.doi.org/10.1155/2013/291239.

35. Patel N, Gunjana G, Patel S, Thanvi R, Sathvara P, Joshi R. Nutrition and health status of school children in urban area of Ahmedabad, India: comparison with Indian Council of Medical Research and body mass index standards. J Nat Sci Biol Med. 2015; 6(2):372-77.

Table 1: Height, weight and BMI of Himachali girls (N = 749).

Age (year)	N	Height (cm)		Weight (kg)		Body Mass Index (kg / m^2)	
		Mean	SD	Mean	SD	Mean	SD
10	79	139.4	6.45	29.3	4.85	14.9	1.74
11	106	142.1	7.79	32.2	6.51	15.9	2.45
12	110	148.1	7.53	37.8	7.46	17.2	2.90
13	90	153.4	5.93	41.4	7.95	17.5	2.67
14	75	154.1	5.24	43.5	7.39	18.3	2.79
15	89	155.4	5.28	43.9	5.75	18.2	2.19
16	112	156.1	5.06	46.2	8.65	18.9	3.37
17	88	156.6	5.48	46.5	6.45	19.0	2.36
Total	749	150.6	8.76	40.1	9.20	17.5	2.94

Table 2. Prevalence of stunting across all age groups

Age group (N)	Stunted		Severe stunted		All stunted	
	N	%	N	%	N	%
10 (79)	2	2.5	0	0	2	2.5
11 (106)	19	17.9	0	0	19	17.9
12 (110)	11	10	3	2.7	14	12.7
13 (90)	8	8.9	0	0	8	8.9
14 (75)	7	9.3	0	0	7	9.3
15 (89)	8	9	1	1.1	9	10.1
16 (112)	5	4.5	0	0	5	4.5
17 (88)	4	4.5	0	0	4	4.5
All (749)	64	8.5	4	0.5	68	9

Table 3. Prevalence of wasting across all age groups

Age group (N)	Wasted		Severe wasted		All wasted	
	N	%	N	%	N	%
10 (79)	16	20.3	5	6.3	21	26.6
11 (106)	15	14.2	9	8.5	24	22.6
12 (110)	9	8.2	5	4.5	14	12.7
13 (90)	13	14.4	4	4.4	17	18.9
14 (75)	8	10.7	2	2.7	10	13.3
15 (89)	8	9	3	3.4	11	12.4
16 (112)	13	11.6	6	5.4	19	17.0
17 (88)	11	12.5	5	5.7	16	18.2
All (749)	93	12	39	5	132	17.6

Table 4. Prevalence of overweight and obesity across all age groups

Age group (N)	Overweight		Obese		All overnutrition	
	N	%	N	%	N	%
10 (79)	1	1.3	0	0	1	1.3
11 (106)	6	5.7	0	0	6	5.7
12 (110)	5	4.5	4	3.6	9	8.2
13 (90)	1	1.1	1	1.1	2	2.2
14 (75)	2	2.7	1	1.3	3	4.0
15 (89)	2	2.2	0	0	2	2.2
16 (112)	8	7.1	1	0.9	9	8.0
17 (88)	0	0	0	0	0	0
All (749)	25	3	7	1	32	4.3

Figure 1: - Mean height of the Himachali girls at different age groups compared to the corresponding 50th percentile values of Indian growth standard.
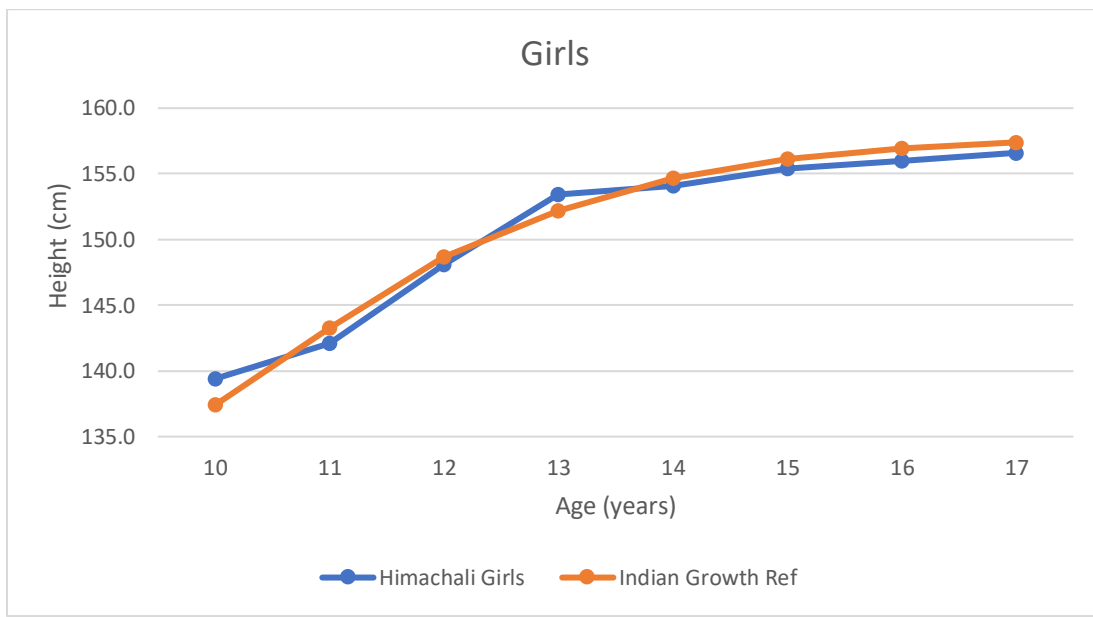

Figure 2:- Mean weight of the Himachali girls at different age groups compared to the corresponding 50th percentile values of Indian growth standard.
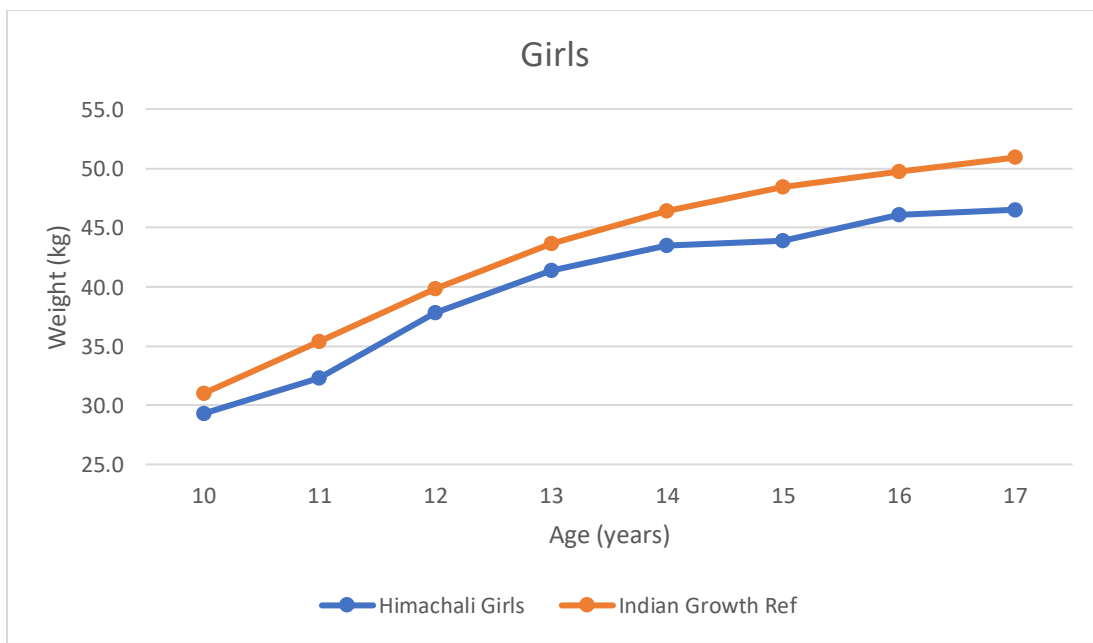
Research Paper   © 2012 IJFANS. All Rights Reserved. UGC CARE Listed (Group -I) Journal

Figure 3. Prevalence of under and overnutrition across early and late adolescent categories

	Stunted	Wasted	All Undernutrition	All overnutrition
Early	10.9	18.7	29.6	4.6
Late	6.2	15.9	22.1	3.8
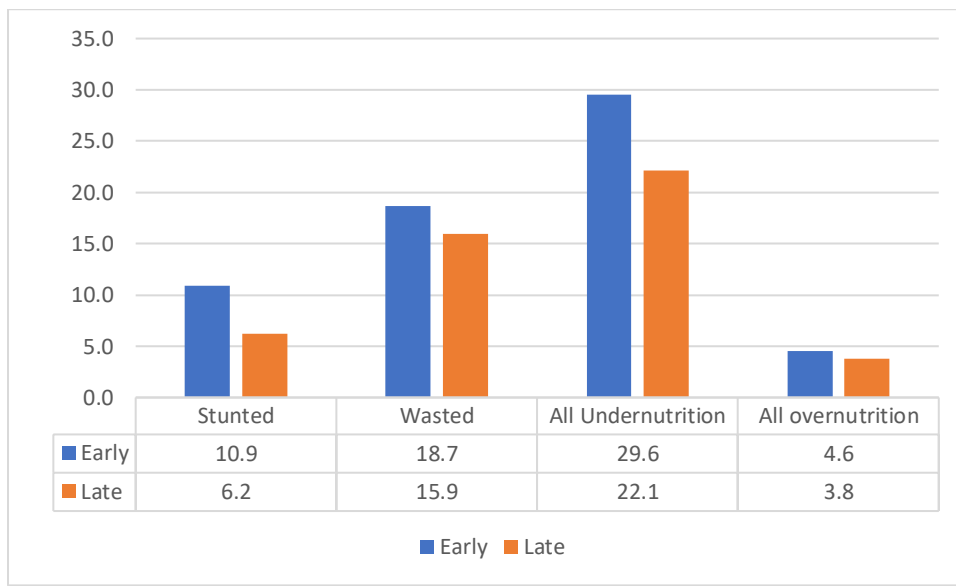
Figure 4. Comparison of height of the Himachali girls with other Indian populations

	Present study	Agarwal 1992	Venkaiah 2002	Chakrabarty 2008	Talwar 2010	Marhwa 2011	Pal 2017
Series1	150.7	150	143.1	142.2	152.3	152	143.5
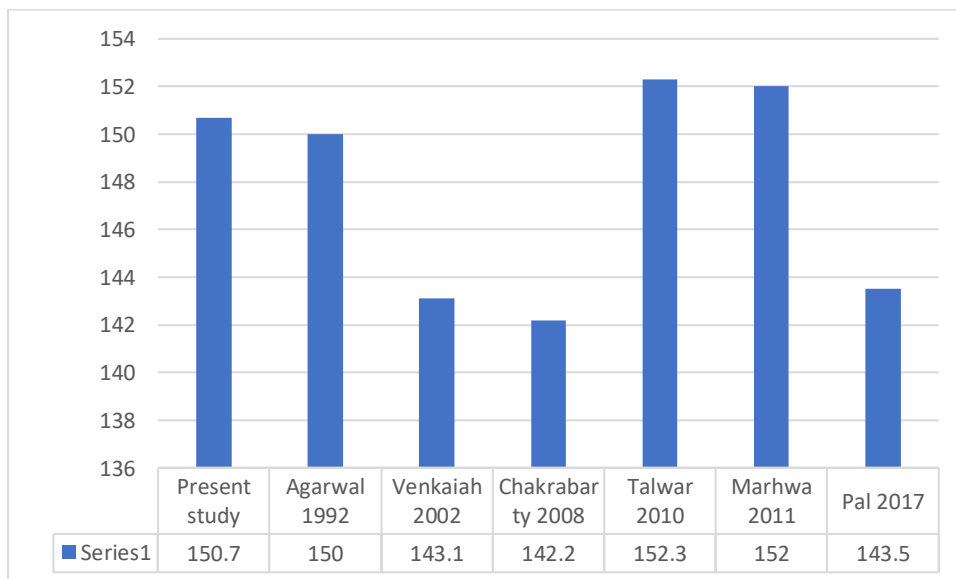
Figure 5. Comparison of weight of the Himachali girls with other Indian populations

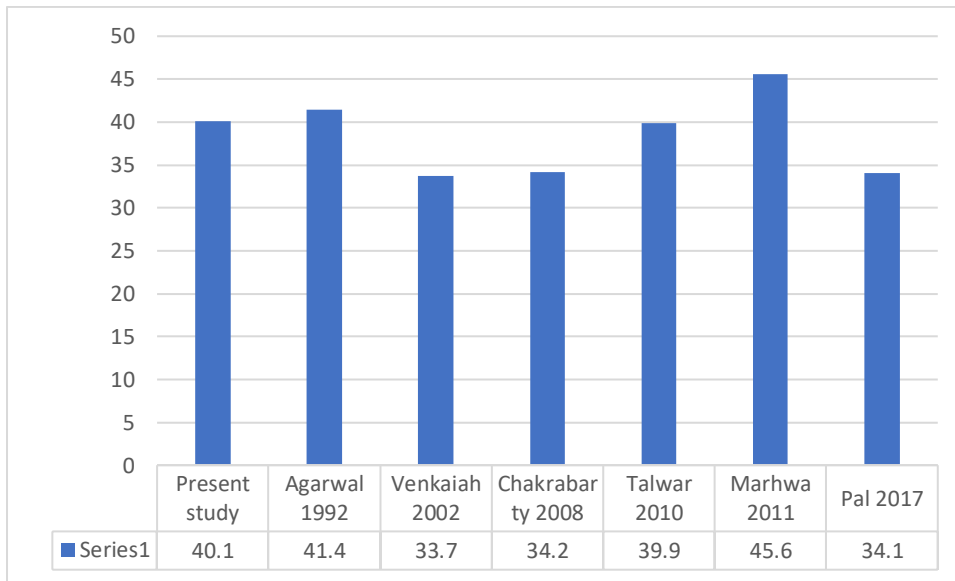|	Present study	Agarwal 1992	Venkaiah 2002	Chakrabarty 2008	Talwar 2010	Marhwa 2011	Pal 2017
■ Series1	40.1	41.4	33.7	34.2	39.9	45.6	34.1

Figure 6:- Prevalence of Stunting of Himachali girls as compared to other Indian studies
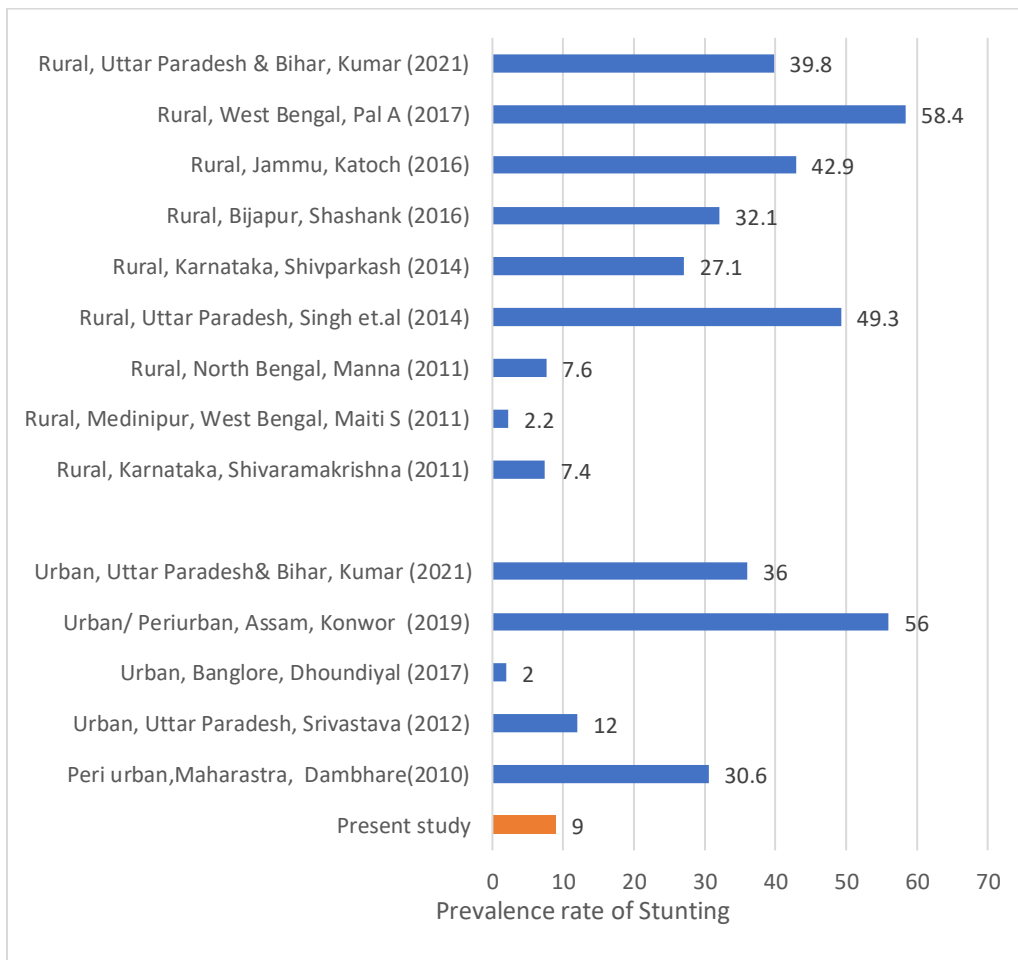
Figure 7:- Prevalence of thinness of Himachali girls as compared to other Indian studies
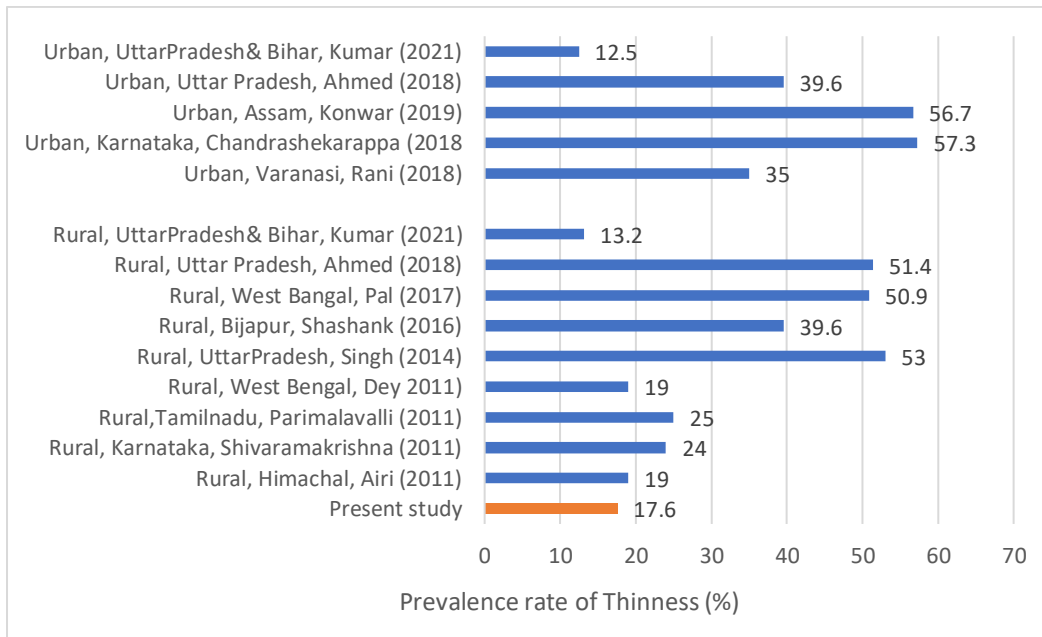

Figure 8: – Prevalence of overweight of Himachali girls as compared to other Indian studies