

Prevalence of stunting and thinness among rural adolescents of Darjeeling district, West Bengal, India

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Abstract

Background: The primary causes of undernutrition in India are its large population, socio-economic differences and inadequate access to health facilities. Nutritional assessments among adolescents are important as they are the future parents and constitute a potentially susceptible group. Studies on the assessment of nutritional status of adolescents are less in number and a National database has not yet been developed. The present cross-sectional investigation evaluates the prevalence of undernutrition among rural adolescents (10 years - 17 years) from Darjeeling District, West Bengal, India.

Methods: The present investigation was conducted among 726 rural school-going adolescents (376 boys and 350 girls) belonging to the Rajbanshi, Bengali Muslim and Bengali Caste communities. The nutritional status was assessed in terms of stunting (Height-for-age below 3rd percentile) and thinness (BMI-for-age below 5th percentile).

Results: The overall prevalence of stunting and thinness were found to be 46.6% and 42.4% respectively. A high prevalence of stunting was found among boys (43.1%) and girls (50.3%) ($p > 0.05$). The highest prevalence of stunting was observed among boys of 17 years (63.6%) and among girls of 15 years (70.0%). The overall mean BMI for girls was slightly higher than boys (16.8 ± 3.4 kg/m² and 15.9 ± 2.1 kg/m² respectively). A higher prevalence of overall thinness was found among boys (53.1%) than girls (32.0%) ($p < 0.05$).

Conclusions: There was a very high prevalence stunting and thinness among the boys and girls. There was a significant difference in the prevalence of undernutrition in terms of age and sex amongst them. Nutritional intervention is necessary to ameliorate their nutritional status. The results of the present investigation will help policy makers to formulate various developmental and health care programmes.

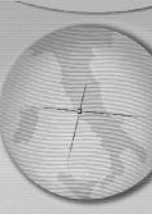
Key words: adolescent, stunting, BMI, thinness, anthropometry, West Bengal, India

Introduction

Nutritional status is now recognized to be a prime indicator of the health of individuals. The World Health Organization (WHO) believes that the ultimate objective of nutritional assessments is the improvement of human health [1]. The prevalence of undernutrition is a major public health concern in many of the developing countries in Asia. Due to its immense population size, socio-economic disparities, illiteracy and inadequate access to health facilities, India is no exception. As a result, assessments of nutritional status have the potential to play significant roles in formulating developmental strategies in this country. Anthropometry is the single-most universally applicable, inexpensive and non-invasive technique available to researchers for the

assessment of body size and proportion [2]. This technique has been widely utilized to assess the nutritional status of individuals belonging to different Indian and non-Indian communities [3-16].

In India, one of the important aims of nutritional research is to focus on the prevalence of undernutrition among adolescents. The adolescent period is a very important phase in the life span of an individual. It is defined as the period of transition between childhood and adulthood and is characterized by an exceptionally rapid rate of growth [17]. It is the time when the nutrient requirements of the body are high. The nutritional status of adolescents needs to be monitored closely as they constitute the next generation of parents. The nutritional



status of the adolescent girls, the future mothers, bear special significance as they contribute significantly to the nutritional status of the community [18]. The number of adolescents in India has been estimated to be about 7.0% (69.7 million) of the total population [18]. More importantly, a very high proportion of girls (23.0%) get married at an early age and even before completing their growth [19] and at least a quarter of them conceive early [18]. There is also a need to develop a database on the nutritional status of adolescents from different parts of the country. Such a database is lacking at the moment. This will enable the government and non-governmental agencies to formulate policies and initiate strategies for well-being of the adolescents. The fact that the majority of the population is underprivileged and reside in the rural areas also lay credence to the significance of such investigations. There is little available information on the nutritional status of adolescents from India, although some important scientific papers are mentionable here [18, 20-25]. The National Nutrition Monitoring Bureau (NNMB) has also made some contributions on the issue [18].

It is only recently that some efforts have been made to include adolescents as beneficiaries in some of the health care and nutritional intervention programmes by the Government of India. One such programme is the Integrated Child Developed Services (ICDS) scheme [26]. The ICDS scheme is the largest national programme for the promotion of the mother and child health care. The scheme includes pre-school education, supplementary nutrition, immunization, health check-up, referral services, nutrition and health education [26].

Popularly known North Bengal, the northern part of the state of West Bengal, India, comprises of six districts and is the home to a number of tribal communities (Lepcha, Rabha, Meche, Toto, Oraon, Santal and Munda) and non-tribal communities (Rajbanshi, Bengali Caste and Bengali Muslim). Given the region's general backwardness in health-care, educational and medical facilities, the above-mentioned communities are very vulnerable to undernutrition. There are just a handful of studies on the assessment of nutritional status of individuals belonging to these communities. The study of Banik et al. [27] among the Dhimals and that of Mittal and Srivastava [28] among the Oraons may be cited here. However, there appears to be a complete absence of studies on the assessment of the nutritional status among

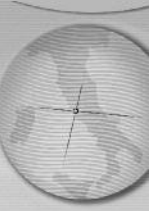
adolescents belonging to the various communities of the region.

The present cross-sectional investigation was carried out among adolescent boys and girls (10 years to 17 years of age) belonging to a lower socio-economic group in the Phansidewa block of Darjeeling district, West Bengal, with the aim to assess the prevalence of undernutrition and document the gender differences in undernutrition among them. The Phansidewa block has a total population of 171306 individuals (87782 males and 83524 females) and consists of seven Gram Panchayets (GPs). The GPs are local-level village governing bodies set up by the government. The predominant communities of this block are the Rajbanshi, Bengali Muslim and Bengali Caste. There are five secondary schools in this Block and the total literacy rate is 41.37% (51.85% male and 30.89% female). The area is rural and the predominant occupation is agriculture. There are some government health care and supplementation programmes in place in the area under investigation. These include different programmes run by the ICDS scheme and a mid-day meal facility in the schools. The results of this investigation will help policy makers to formulate policies and initiate strategies for the well-being of the adolescents and add to the meager national data available on their nutritional status.

Methods

All the five secondary schools under Phansidewa Block were visited prior to the commencement of the investigation. These schools had a substantial number of students belonging to the Rajbanshi, Bengali Muslims and Bengali Caste communities. The total student strengths of the schools were almost identical. The 'Najrul Satabarshiki Vidyalaya' located in village 'Rabvita' was finally selected because of its location and accessibility. This village is located in the 'Jalash Nijam Tara' GP which has a total population of 26368 individuals (13754 males and 12614 females).

The Najrul Satabarshiki Vidyalaya comprised of classes from 5th standard to 10th standard and the total number of students was 1168. The students belonging to the adolescent category were selected by the method of multi-stage stratified sampling. Initially students belonging to the three communities were identified by utilizing their surnames and subsequently their ethnicity was verified from the school records. A total of 796 subjects were identified and among them the adolescents belonging to the age group of 10 years to 17 years were approached. The number of adolescents thus identified and approached was



732 (380 boys and 352 girls). Finally 726 adolescents (376 boys and 350 girls) agreed to participate in the investigation (participation rate: 99.2%). A modified version of the socio-economic scale of Kuppuswamy as proposed by Mishra and Singh [29] was utilized to determine their socio-economic group. A pre-structured schedule containing different socio-demographic and socio-economic variables (age, parents' occupation, education, monthly income, family size, birth order, number of siblings and ethnicity) was used for this purpose. The schedule was completed by both school and household visits. Analysis of the schedules showed that all the 726 students belonged to a lower socio-economic group.

Height and weight of the subjects were recorded using the standard techniques of Weiner and Lourie [30]. Height was taken with the help of an anthropometer to the nearest 0.1 cm. The weight was recorded to the nearest 0.5 kg using portable weighing machine and wearing minimum clothing. The age of the children was recorded from the school records and their birth certificates. Body mass index (BMI) was computed by using the standard equation $BMI = \text{weight (kg)} / \text{height (m)}^2$. The Technical Errors of Measurements were calculated following Ulijaszek and Kerr [31] and the values were found to be within acceptable limits.

Recommended anthropometric parameters and indices of WHO [2] have been used to assess the nutritional status of the boys and girls. The height-for-age index measured linear growth retardation, primary reflecting chronic under-nutrition. The height-for-age below the 3rd percentile of the National Centre of Health Statistics (NCHS) reference value was classified as stunting [32]. The thinness and overweight were determined by using WHO recommended age specific cut-off points of BMI based on the Nutritional Health and Nutrition Examination Survey (NHANES) reference value where the BMI-for-age below 5th percentile of NHANES value was classified as thinness or chronic energy deficiency (CED). The BMI-for-age above 85th percentile of NHANES reference value was considered as overweight [2].

The investigation was conducted in accordance with the ethical guidelines of human experiments as laid down in the Helsinki Declaration of 2000 [33]. The necessary permissions were obtained from the school authorities prior to conducting this investigation.

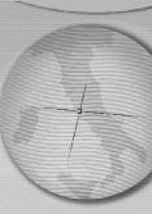
The data was statistically analyzed utilizing SPSS (version. 15.0) for Windows. Chi-square analysis was utilized to assess the differences in the overall prevalence of stunting and thinness among the

boys and girls. Chi-square analysis was also used to analyze the differences in stunting and thinness between groups and also between sexes. The differences were considered to be statistically significant at $p < 0.05$ level.

Results

The overall prevalence of stunting and thinness among adolescents in the present investigation was observed to be 46.6% and 42.4% respectively. The prevalence of overall overweight was found to be almost negligible (0.3%). The age specific mean and standard deviation of weight, height and prevalence of stunting (below 3rd percentile of NCHS reference value) is presented in Table 1. The prevalence of stunting was higher among girls (50.3%) than their male counterparts (43.1%). The differences were statistically not significant ($p > 0.05$) in the overall prevalence of stunting between boys and girls. With the increase in age, girls showed a higher prevalence of stunting (Figure 1). When the age wise prevalence of stunting was considered, the highest prevalence was observed to be among 17 year old boys (63.6%) and 15 year old girls (70.0%). The age wise prevalence of stunting ranged from 21.9% (11 years) to 63.6% (17 years) among boys and 30.4% (10 years) to 70.0% (15 years) among girls. The age specific prevalence of stunting between all age groups among boys and girls (Table 2) was statistically not significant ($p > 0.05$).

The age specific means and standard deviations of BMI and prevalence of thinness among the studied subjects are depicted in Table 3. There was a positive linear increase of mean height and weight as both boys and girls approached higher ages from 10 years to 17 years. The mean BMI also increased when boys and girls approached higher ages except in the age of 17 years among girls. The overall mean BMI for girls ($16.8 \pm 3.4 \text{ kg/m}^2$) was slightly higher than boys ($15.9 \pm 2.1 \text{ kg/m}^2$). The highest progressive increase of mean BMI was observed to be 0.6 kg/m^2 (aged 16 years - 17 years) and 1.1 kg/m^2 (aged 11 years - 12 years) among boys and girls respectively. When the prevalence of thinness (5th percentile of BMI for age NHANES references) was evaluated, boys (52.1%) were more affected than girls (32.0%). The overall prevalence of thinness among boys and girls was found to be statistically significant ($p < 0.05$). The boys and girls of early adolescence showed a higher prevalence of thinness (Figure 2). The age wise prevalence of thinness was higher at 69.0% and 73.9% in 10 years among both boys and girls respectively. The number of adolescents below the 5th percentile BMI-for-age



of NHANES ranged from 30.4% (17 years) to 69.0% (10 years) among boys and 73.9% (10 years) to 8.3% (16 years) among girls. The prevalence of thinness between the age groups among the boys and girls was statistically not significant ($p>0.05$) but exceptions were

observed in the ages of 12 years, 14 years and 16 years (Table 2).

Discussion

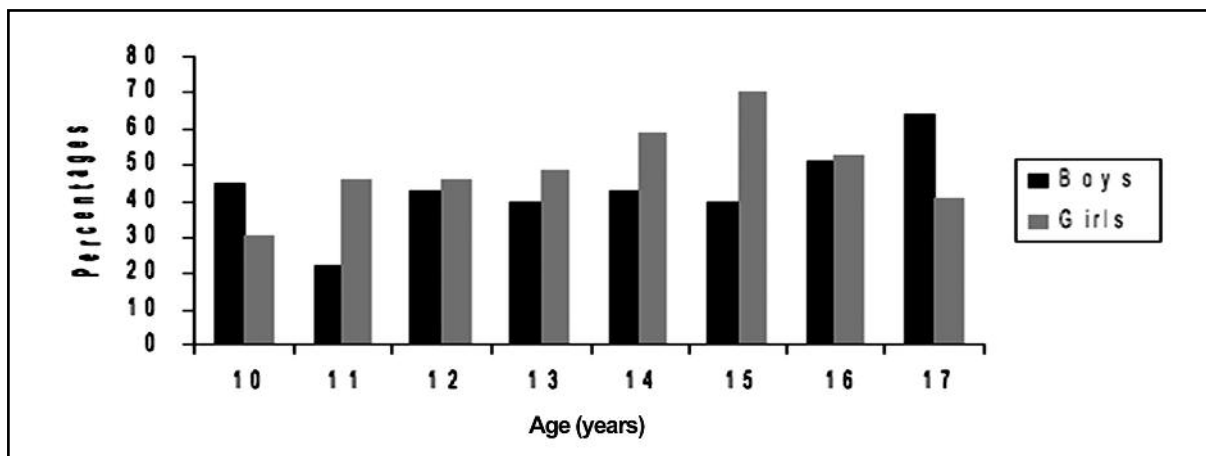
The present investigation is based on the WHO proposed cut-offs given for the assessment of

Table 1. Mean \pm SD of weight, height and prevalence of stunting (<3rd percentile) among the adolescent boys and girls.

Age (years)	Boys				Girls			
	No. of subjects	Weight (kg)	Height (cm)	Stunting (<3 rd percentile)	No. of subjects	Weight (kg)	Height (cm)	Stunting (<3 rd percentile)
10	29	23.2 ± 3.7	128.9 ± 7.1	13 (44.8)	23	24.9 ± 5.7	133.8 ± 10.9	7 (30.4)
11	32	28.0 ± 4.9	138.3 ± 7.8	07 (21.9)	37	26.9 ± 5.1	135.3 ± 6.9	17 (46.0)
12	61	29.8 ± 6.0	141.1 ± 9.4	26 (42.6)	59	32.5 ± 5.5	142.7 ± 6.4	27 (45.8)
13	58	33.3 ± 6.7	146.6 ± 9.8	23 (39.7)	72	34.3 ± 6.8	145.4 ± 7.5	35 (48.6)
14	75	36.7 ± 6.8	151.4 ± 9.6	32 (42.7)	51	37.4 ± 5.9	147.71 ± 5.6	30 (58.8)
15	45	42.1 ± 7.2	156.1 ± 9.5	18 (40.0)	40	38.5 ± 7.3	148.02 ± 5.9	28 (70.0)
16	43	45.2 ± 6.1	160.2 ± 6.9	22 (51.2)	36	41.4 ± 5.4	148.9 ± 6.2	19 (52.8)
17	33	47.6 ± 6.0	161.2 ± 6.2	21 (63.6)	32	43.4 ± 5.5	152.3 ± 6.7	13 (40.6)
Total	376 (100.0)	-	-	162 (43.1)	350 (100.0)	-	-	176 (50.3)

Figures in parenthesis indicate percentages.

Figure 1. Prevalence of stunting among the adolescents.



undernutrition among adolescents in terms of thinness and stunting. It is well known that contemporary India consists of a sizable number of ethnic and indigenous elements having enormous amounts of ethnic and genetic diversity [34,35]. Although the WHO expert committee [2] has recommended the NCHS [32] reference data

for the assessment of adolescent undernutrition, there could be an element of doubt regarding the suitability of the NCHS reference data due to the ethnic variations in growth and body composition. However, it has been opined that the WHO criteria should be used to assess the nutritional status of adolescents to avoid

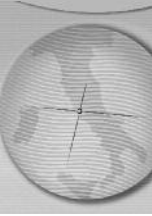
Table 2. Test for significant differences in nutritional status between the adolescent boys and girls using chi-square analysis.

Category	Age (years)	Stunting (<3 rd percentile)		Thinness (<5 th percentile)	
		Chi-value	p	Chi-value	p
		Boys vs. Girls	10	0.51	0.48
11	2.17		0.14	0.02	0.90
12	0.05		0.83	4.60	0.03
13	0.40		0.52	2.75	0.10
14	1.06		0.30	5.39	0.02
15	2.28		0.13	1.57	0.21
16	0.01		0.94	5.09	0.02
17	1.09		0.29	0.00	0.95
Total	1.38	0.24	12.28	0.00	

Table 3. Mean ± SD of BMI and prevalence of thinness (<5th percentile of BMI-for-age) among the adolescent boys and girls.

Age (years)	Boys			Girls		
	No of subjects	BMI Mean ± SD	Thinness (<5 th percentile)	No of subjects	BMI Mean ± SD	Thinness (<5 th percentile)
10	29	13.9 ±1.4	20 (69.0)	23	13.9 ±1.1	14 (73.9)
11	32	14.5 ±1.6	20 (62.5)	37	14.8 ±2.3	22 (59.5)
12	61	15.0 ±1.3	35 (57.4)	59	15.9 ±1.7	16 (27.1)
13	58	15.3 ±1.5	34 (58.7)	72	16.8 ±5.7	25 (34.7)
14	75	16.0 ±1.8	44 (48.7)	51	17.8 ±1.9	13 (25.5)
15	45	17.0 ±1.8	18 (40.0)	40	17.9 ±2.4	09 (22.3)
16	43	17.6 ±1.9	15 (34.9)	36	18.6 ±1.9	03 (8.3)
17	33	18.2 ±2.1	10 (30.4)	32	18.5 ±2.0	10 (31.3)
Total	376	15.9 ±2.1	196 (52.1)	350	16.8 ±3.8	112 (32.0)

Figures in parenthesis indicate percentages.



unnecessary confusion [2, 36].

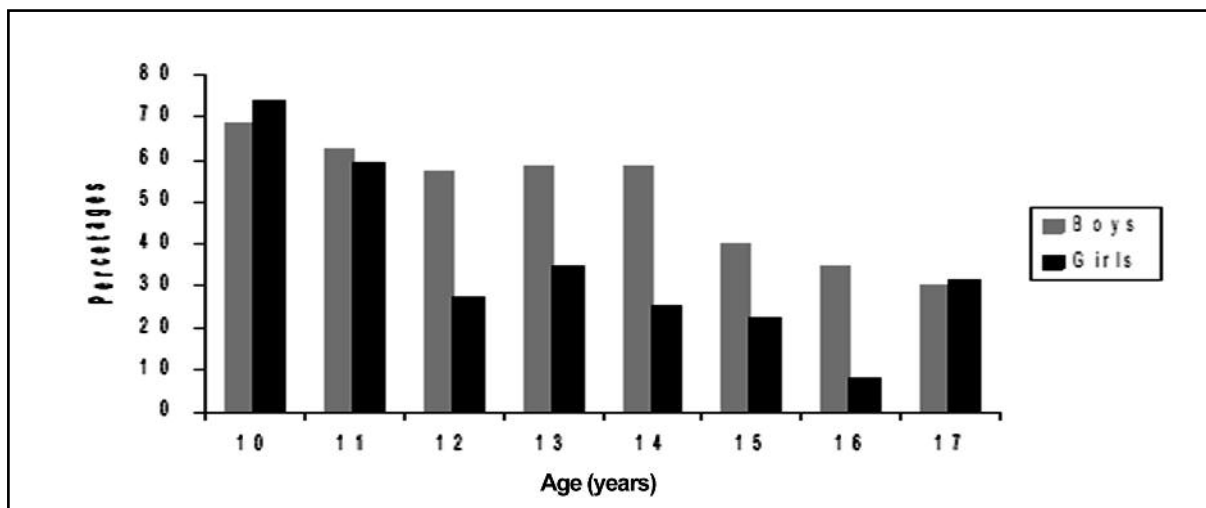
It is apparent from this investigation, that there is a very high prevalence of undernutrition among rural adolescents as the prevalence of stunting and thinness was found to be 46.6% and 42.4% respectively. The extent of undernutrition was higher than those reported among Nepali refugees by Woodruff et al. [37] (34.0%). The findings are also markedly higher than the reported values from Ethiopia [38] but lower than those of Kenyan refugees reported by the International Rescue Committee [39].

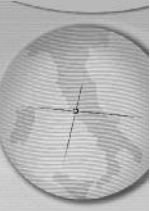
From Table 1 it can be observed that the prevalence of stunting was higher among girls (50.1%) than boys (43.1%) and the differences were observed to be statistically not significant ($p > 0.05$). When the prevalence of stunting between boys and girls of each age was considered, the differences were statistically not significant ($p > 0.05$). The WHO Report on Regional Consultation on the nutritional status of adolescents reported that prevalence of stunting among girls was 45.0% and that among boys was 20.0%, with an average of 32.0% in both sexes [40]. In a recent study among adolescents, Medhi et al. [21] reported that 50.1% of boys and 43.1% of girls from Assam suffered from stunting. A high prevalence of stunting (52.5%) has also been documented from West Bengal by Das et al. [22]. Deshmukh et al [36] also reported a high prevalence of stunting (50.7%) from rural Wardha. Utilizing the data from the National Nutrition Monitoring Bureau (NNMB), Venkaiah et al. [18] reported about 39.0% of the rural adolescents to be stunted. However, low prevalence of stunting has also been reported in the existing literature. Malhotra and Passi [41] reported the prevalence of stunting to be 29.7% among rural adolescent

girls from in North India. A low prevalence of stunting has also been reported by Anand et al. [42]. The basic reason behind stunting indicates the long term cumulative inadequacies of health and nutrition and an insufficient intake of nutrients during the early stage of childhood. It had been opined earlier by Measham and Chatterjee [43] that one of the key causes of undernutrition among Indian communities was the lack of access to insufficient foods and resource amenities. The prevalence of lower nutritional status among girls is another well known and accepted fact in almost every Indian community [21, 41]. Numerous studies have already documented the discriminations made against the girl child in India [44, 45].

In the present investigation BMI-for-age was utilized as an indicator of thinness and overweight. The WHO expert Committee [2] has been recommended that it is the best indicator for the adolescents to assess undernutrition (thinness) or overweight. There are a number of studies reporting the prevalence of thinness utilizing BMI-for-age as an indicator among adolescents in India [18, 21, 36, 41, 42, 46, 47]. It is evident from Table 3 that the prevalence of thinness was higher among boys (52.1%) than girls (32.0%). The differences were statistically significant in case of overall prevalence ($p < 0.05$). The prevalence of thinness was significantly higher in the early age groups in most of the cases, but decreased with age. A similar trend has been reported by Sahabuddin et al. [48] who opined that the prevalence of thinness decreased with age. It has also been observed in case of thinness that adolescent boys were more affected than adolescent girls (59.4% versus 41.3%) [21]. Rao et al. [46] utilizing the NNMB data reported a similar

Figure 2. Prevalence of thinness among the adolescents.





trend regarding the prevalence of thinness among tribal adolescent boys (63.0%) and girls (42.0%) from nine Indian states. In another study, Venkaiah et al. [18] also reported that the prevalence of thinness to be higher in boys (53.1%) than in girls (39.5%). However, Anand et al. [42] reported the prevalence of stunting in the 12 years to 18 years age group to be 37.2% among girls and 41.0% among boys with an overall prevalence of 38.5%. Low prevalence thinness among adolescent girls (30.6%) has also been reported from North India [41]. It is however now generally accepted that there is a high prevalence of thinness among Indian communities with more than 50.0% of adolescents being affected [36, 47].

Studies have also documented the prevalence of overweight from different Indian populations. The prevalence of overweight in the present investigation is almost negligible. Only 0.3% of total adolescents were suffering from overweight. Low prevalence of overweight were also reported among rural adolescents from Assam (0.3%) [21] and rural Wardha (2.0%) [36]. A marginally higher prevalence of overweight (5.0%) has been reported in Bengali adolescents [47].

It can be summarized that the rural adolescents in the present investigation are facing a great risk in terms of nutritional stress which is even more pronounced among girls. The poor nutritional status of the adolescents, particularly girls, has

important implications in terms of physical work capacity and adverse reproductive outcomes [2]. These delicate consequences of adolescence of undernutrition were subsequently confirmed by the other researchers among different Indian communities [18, 49].

In conclusion, the present investigation has successfully documented the prevalence of undernutrition in terms of stunting and thinness among a rural adolescent sample from Darjeeling district of West Bengal. There was a very high prevalence stunting and thinness among boys and girls. There was a significant difference in the prevalence of undernutrition for age and sex among the adolescent with respect to the different nutritional indicators. The results of the present investigation will be useful for policy makers in their endeavor to formulate various developmental and health care programmes. Nutritional intervention is also necessary to ameliorate the nutritional status among the studied adolescents.

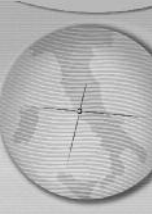
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