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Research article

A CROSS SECTIONAL STUDY TO ASSESS THE PHYSICAL GROWTH OF ADOLESCENTS IN URBAN VADODARAVijayataSengar¹and Kavita Sharma²¹PhD Scholar, ²PhD Advisor, ¹Department of Foods and Nutrition, Faculty of Family and Community Sciences, the Maharaja Sayajirao University of Baroda, Gujarat, India.

ABSTRACT: Adolescence, a period of transition between childhood and adulthood, occupies a crucial position in the life of human beings. Anthropometry is especially important during adolescence because it allows the monitoring and evaluation of nutritional status of adolescents. A school based cross sectional study was conducted to assess the nutritional status of adolescents in urban Vadodara. Seven hundred and sixty seven children were enrolled from two schools studying in standard Vth to XIth. Nutritional status of a total of 443 boys and 324 girls between 7.5 to 18 years was assessed using standard anthropometric measurements for age, weight and height assessment. Mean age of the children was found to be 12.25±2.03 years. Prevalence of thinness was 10.8% while 15.4% of children were overweight. Prevalence of malnutrition was more in boys as compared to girls which was mainly during early and mid adolescence. On comparing with the reference data for BMI for age it showed a clear shift towards left. Stunting was seen in 13.6% percent of the subjects. Thus, there is a clear indication that dual burden of malnutrition exists in the urban settings and there is a strong need for proper nutrition during the early years of adolescence.

Keywords: Adolescence, anthropometry, Growth pattern, stunting, thinness, overweight, BMI

Adolescence is characterized by an exceptionally rapid rate of growth. The peak rates of growth are exceeded only during the fetal life and early infancy (Tanner JM, 1978). However, in comparison to infancy, there is much more individual variation both in timing and in degree of growth. Adolescence is a period of increased nutritional requirements and adolescent anthropometry varies significantly worldwide.

1.2 million adolescents reside worldwide, forming 18 percent of world population. The vast majority of adolescents (88%) live in developing countries. India has largest national population of adolescents (243 millions) which is almost one-fifth of the total population (UNICEF, 2011).

The growth velocity is slower during the early school years (5-9 yrs), 80% of adolescent growth is completed in early adolescence (10-15 years); there is marked deceleration in weight and height velocity in the post-pubertal phase (Tanner JM, growth, 1962). Adolescent growth spurt in girls begins about 10 years and peak velocity is at about 12 years. The adolescent growth spurt in boys begins 2-3 years later than girls and peaks by 16-17 years. This age of adolescent growth spurt varies from country to country, being lowest in developed countries and highest in poorest countries (Tanner JM, growth, 1962).

Malnutrition (undernutrition or overnutrition) which refers to an impairment of health either from a deficiency or excess or imbalance of nutrients, is of public health significance among adolescents all over the world. It creates lasting effect on the growth, development and physical fitness of a person. It is well recognized worldwide that anthropometric measurements are indispensable in diagnosing undernutrition. It has now been well established that the body mass index (BMI) is the most appropriate variable for determining nutritional status among adolescents (WHO, 1995).

Stunting (short stature) in both adolescent boys and girls as suggested by Height for age z scores (<-2SD) (De Onis et al., 2007) indicates long term undernutrition. Under weight in girls is of particular interest because it results in poor pregnancy outcomes, in particular low birth weight (Kramer, 1987). School age children who suffered from early childhood malnutrition have generally been found to have poorer IQ levels, cognitive function, school achievement and greater behavioral problems than matched controls (Grantham-McGregor, 1995), but this has not been investigated among adolescents. Poor nutrition among adolescents resulting in short stature and low lean body mass is associated with many concurrent and future adverse health outcomes (Thame M, et al., 1997, Ravindra C 1989).

The changes in the lifestyles and eating habits of urban adolescents mainly lack of physical activity, increase in consumption of junk foods, etc. have led to increase in the incidence of chronic degenerative diseases which have their roots in adolescence. Thus, overweight or obesity as suggested by BMI for age z scores in adolescents is important to know because if it is controlled during this stage then it reduces the risk of chronic degenerative diseases occurring in adulthood. In view of the fact that over nutrition in childhood and adolescence is associated with increased risk of CVD in adult life, it is essential to improve physical activity and promote balanced food intake in adolescents (4). School health services provide an ideal platform to detect the health problems early and treat them. Thus it is clear that adolescence is a crucial stage in life as adolescents are tomorrow’s future. There is a dearth of data on adolescent children especially in urban settings and the need of the hour is to find out the prevalence of malnutrition amongst them in regards to both under and over nutrition. Data on prevalence of malnutrition would help to identify the various crucial stages during adolescence which would provide a base for developing evidence-based policies and programmes that support adolescent health.

Therefore, the present study was carried out to assess the nutritional status of adolescents using anthropometry in a school setup in urban Vadodara.

METHODS AND MATERIALS

Two schools were randomly selected from an urban setting. The study subjects comprised adolescents studying in standard Vth to XIth with the age group ranging from 7.5y to 18 years. In all 767 subjects were enrolled. Informed consent was obtained from the Principals of the schools and also from the parents. Height of the student’s was measured using a flexible fibre-glass tape to the nearest 0.1cms. Weight was measured using a digital platform scale to the nearest 100 gms. Nutritional status was assessed using the WHO 2007 standards for height for age and BMI for age. Data generated was entered and analyzed using WHO anthropus software and SPSS 17.0 software.

Ethical consideration

Consent of the ethical committee was taken prior to conducting the study. (Ethical clearance no: F.C.Sc./FND/ME/90)

RESULTS

A total of 767 students were enrolled for the study, out of which 57.8% were boys and 42.2% were girls. Mean age of the children was found to be 12.25± 2.03 years. The distribution of children according to age is shown in (Figure1). Almost 70% of boys and nearly 63% of girls were between 10- <14 years of age.

Table 1: Anthropometric Measurements of the Subjects

Parameters (Mean± SD)	Boys (N= 443)	Girls (N=324)	Total(N= 767)
Age (yrs.)	12.12± 1.91	12.43± 2.17	12.25± 2.03
Weight (Kg.)	41.30± 11.24	41.44± 9.88	41.36± 10.68
Height (cm)	153.12± 12.64**	150.66± 9.01	152.08± 11.25
BMI (Kg/m ²)	17.35± 2.99	18.08± 3.20**	17.66± 3.10

**significant at p < 0.001

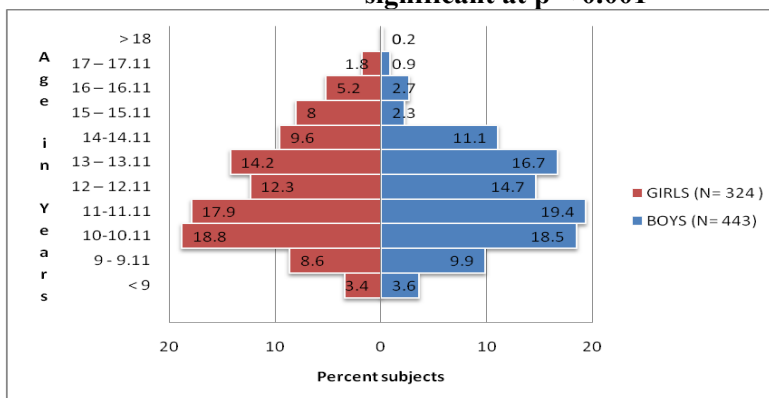


Figure1: Population Pyramid (N=767)

Around 12% of total children were < 10 years, while the remaining were between 14-18 years of age. Thus it can be observed that maximum number of children were under the age group of 10-<14 years.

Overall, boys had a significantly higher value for mean height whereas the girls had significantly higher mean BMI values (Table 1).

As expected the height correlated positively with the age, increasing as age advanced. In boys, mean height ranged from 134.81± 1.43cm at 7 years to 177 ± 0 cm at 18 years. Similarly, in girls, mean height ranged from 137.64± 1.34 cm at 7 years to 156.5±1.71 cm at 17 years age. The mean height of boys at 17 years was 171.25 ± 1.75 cm. As can be observed, while girls started off with a slightly higher height than boys at age 7, the boys outgrew the girls in height by age 17, the changes becoming quite evident from age 13 onwards (Figure 2).

Mean weight of the boys ranged from 28.8 kg at 7 years to 64 kg at 18 years while for girls it ranged from 31.56 kg at 7 years to 50.3 kg at 17 years of age. Mean weight of boys was 57.65 kg at 17 years. As observed in case of height, similarly, mean weight of the boys was lower than girls during the early stages but beyond 13 years of age their mean weights were higher as compared to girls. Thus, although the girls started off with a higher body weight, by 13y of age the boys had higher weights than girls and this trend continued till 18 y of age (Figure 3).

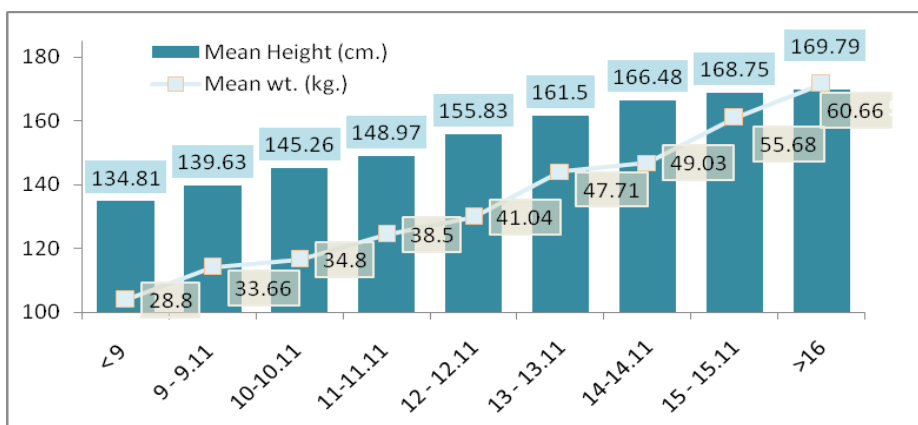


Figure2: Growth pattern in Boys at different ages (N= 443)

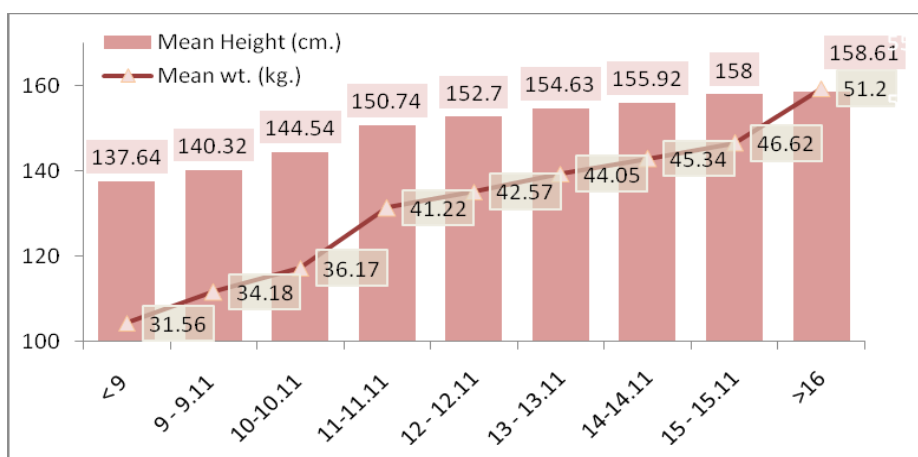


Figure3: Growth pattern in girls at different ages (N= 324)

As a result mean BMI values were higher for girls throughout as compared to boys. Mean BMI ranged from 15.7 ±0.58 kg/m² at 7 years to 20.4± 0 kg/m² at 18 years in boys while for girls it ranged from 16.5±0.61 kg/m² at 7 years to 20.5± 2.02 kg/m² at 17 years. Mean BMI for boys at 17 years was 19.5±2.5kg/m² (Table 2).

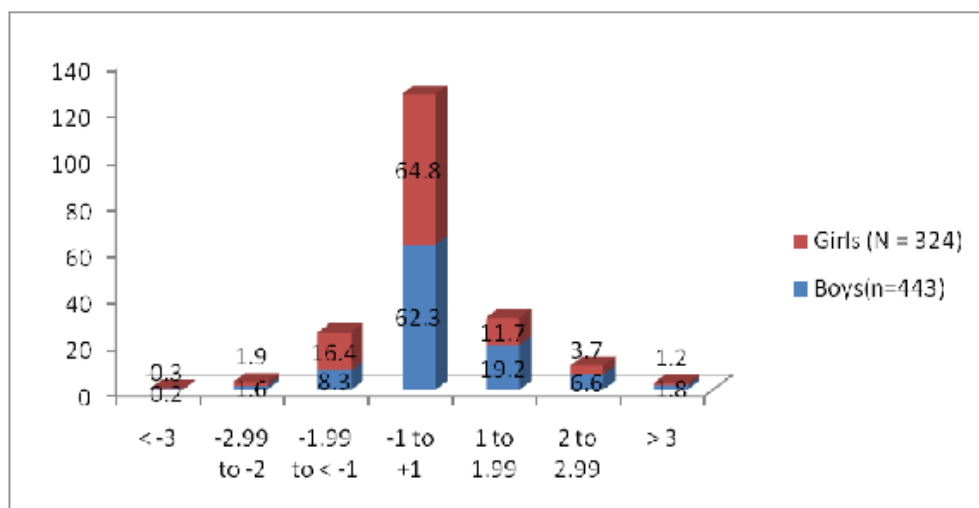


Figure 4: Prevalence of stunting (N=767)

Table 2: Mean weight and Height of the subjects according to age and sex

AGE (yrs.)	Boys (N=443)			Girls (N=324)		
	Weight (Mean ± S.E.)	Height (Mean ± SE)	BMI (Mean ± SE))	Weight (Mean ± S.E.)	Height (Mean ± SE))	BMI (Mean ± SE))
< 9	28.8±1.66 (16)	134.81±1.43 (16)	15.7±0.58(16)	31.56±2.10 (11)	137.64± 1.34 (11)	16.5±0.61 (11)
9 - 9.11	33.66±1.23(44)	139.63±1.06 (44)	17.1±0.51(44)	34.18±1.91 (28)	140.32±1.40(28)	17.1±0.68(28)
10-10.11	34.80±0.86(82)	145.26±0.88(82)	16.4±0.29(82)	36.17± 0.87 (61)	144.54±0.96(61)	17.2±0.31(61)
11-11.11	38.50±0.91(86)	148.97±0.98(86)	17.2 ±0.31(86)	41.22±1.42 (58)	150.74±0.97(58)	18.0±0.53(58)
12 -12.11	41.04±1.03(65)	155.83±1.19 (65)	16.8 ±0.30(65)	42.57±1.30 (40)	152.7 ± 0.88(40)	18.2±0.46(40)
13 - 13.11	47.71±1.10(74)	161.5±0.86 (74)	18.2±0.33(74)	44.05±1.46 (46)	154.63 ±0.92(46)	18.3±0.52(46)
14-14.11	49.03±1.17(49)	166.48±1.01 (49)	17.6±0.34 (49)	45.34±1.02 (31)	155.92±1.21 (31)	18.7±0.45 (31)
15 - 15.11	55.68 ±3.70(10)	168.75±1.23 (10)	19.5± 1.16 (10)	46.62± 1.30 (26)	158±1.09 (26)	18.6±0.47 (26)
16 - 16.11	61.39±3.35(12)	168.71±2.23 (12)	21.7±1.24 (12)	51.51± 1.78 (17)	159.35±1.22(17)	20.2±0.54 (17)
17 – 17.11	57.65±8.42 (4)	171.25 ±1.75 (4)	19.5±2.5 (4)	50.3±5.13(6)	156.5±1.71(6)	20.5±2.02 (7)
≥ 18	64 ± 0 (1)	177±0 (1)	20.4±0 (1)	n= 0	n= 0	n= 0

Prevalence of Malnutrition

Stunting as seen by low height for age was observed in 13.6% subjects. Mild (11.7%) form was more as compared to moderate (1.7%) and severe (0.2%) forms (Figure4). Mild form was more in girls as compared to boys. It was also observed that stunting was highest in mid adolescence seconded by early adolescence, indicating long term malnutrition in these children (Figure 5).

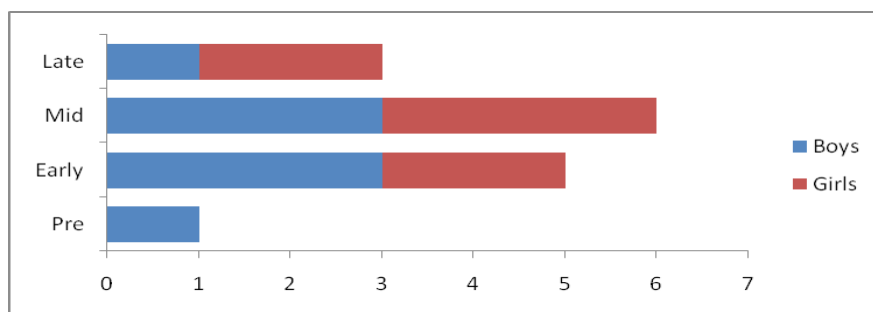


Figure 5: Prevalence of stunting according to stage of Adolescence

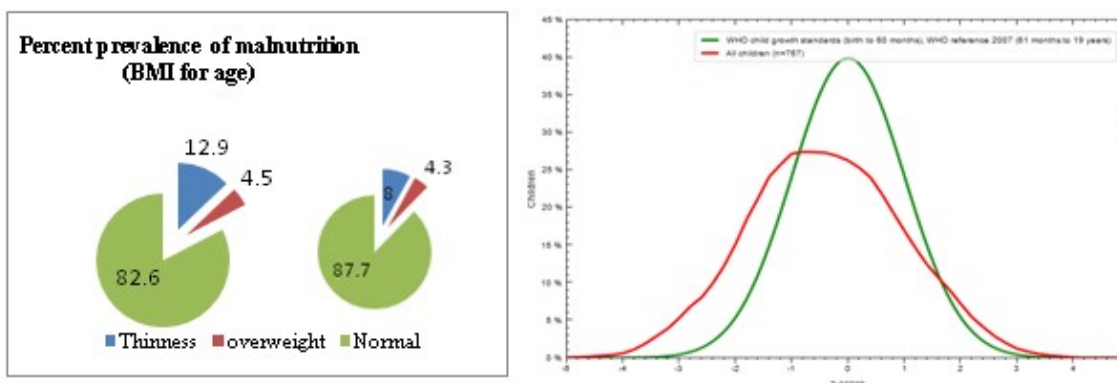


Figure 6: Prevalence of malnutrition (BMI for age)

Prevalence of thinness as shown by BMI for age z scores was found to be 10.8% (<-2SD), simultaneously prevalence of overweight was found to be 15.4% in these children of which nearly 22.9% were obese or severely obese. On comparing the BMI for age z scores with the reference values given by WHO 2007 there was a clear shift towards left (Figure 6), thus, indicating the dual burden of malnutrition amongst the urban adolescents. Prevalence of thinness increased with increasing age amongst boys (Figure 7). Almost 80% of the thin boys were in the early and mid-adolescence stage.

Nearly 7.5% of the girls were thin in all the stages of adolescence except in late adolescence where it increased to 13%. Similarly thinness was highest in the late adolescence stage for boys thus indicating the need for proper nutrition during the early stages of adolescence which can be attributed to the growth spurt (Figure 7).

Similarly amongst the overweight boys 85% of them belonged to early and mid-adolescence age group, whereas 43 % of the overweight girls belonged to the pre adolescence stage (Figure 8).

As seen before as height increment was highest after 13 years of age therefore prevalence of overweight, as assessed by BMI for age, was low amongst girls during these stages. In boys weight gain along with height increment was also high as compared to girls during these stages. Therefore, higher prevalence of overweight in boys can be seen during pre, early and mid-adolescence. Thus, there is a very clear indication that the measures to prevent malnutrition among adolescents should begin well before these stages. Also, nutrition health education if imparted to these children during the early adolescence stage can help improve their nutritional status.

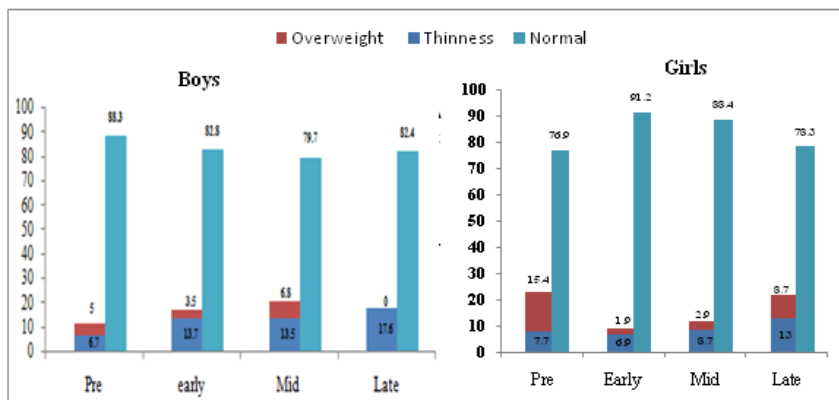


Figure 7: Prevalence of Malnutrition (BMI for age) according to stage of adolescence

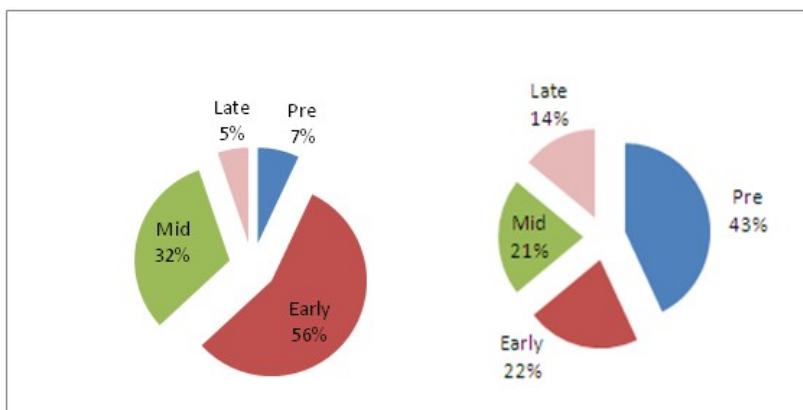


Figure 8: Percent prevalence of overweight according to stage of adolescence

CONCLUSION

The mean height of subjects in the present study was higher but the mean weights of the subjects were lower than those reported by Prajapati et al (2011) among adolescents in urban Ahmedabad (10).

Mean BMI and prevalence of overweight was found to be 17.66 kg/m² and 15.4% respectively which was quite low compared to the subjects in Ahmedabad being 22.71 kg/m² and 19.5% respectively. Prevalence of thinness was very high in comparison being 10.8% in Baroda and 0.5% in Ahmedabad (10). Gandhi H. (2004) conducted a study on prevalence of obesity in school children of urban Vadodara and found the mean BMI values for boys and girls to be 18.01 kg/m² and 19.03 kg/m² respectively. These values are similar to those found in the present study (Table 3).

In the present study 73.8% of the adolescents were normal, 15.4% were overweight and 10.8% were undernourished. Mean weight, height and BMI were low as compared to WHO median values especially for the subjects beyond 14 years of age. Stunting was seen in 13.6% of the subjects of which nearly 2% were severely stunted. A similar study on adolescent girls in Jaipur (2009) also shows that mean height of girls during mid adolescence was quite low as compared to mean height of girls in late adolescence (11). It was also seen the prevalence of thinness was highest in the early years of adolescence which has also been reported by Deshmukh et al (2006).

Sahabuddin et al (2000), also showed that prevalence of thinness decreased as the age increased (12, 13). Similarly the National Nutrition Monitoring Bureau (14) also found that undernutrition decreased from 78% to 66% from 10-13 years and 14-17 years respectively. In a recent study in Wardha early adolescents age group, in which the growth spurt takes place, were observed to be at highest risk of underweight significantly more 73.3% ($p < 0.05$) as compared to late adolescents 26.7%(15). Thus, the study shows that if proper care is taken during the early years of adolescence the prevalence of malnutrition on the whole can be reduced. Focused nutrition and health education if given to the children, their parents and teachers will lead to improvements in the nutritional status of these children

Table 3: Comparison of Mean Age and BMI values with other studies

Place & year	Boys			Girls		
	Mean Age (Y)	Mean BMI (Kg/m ²)	Sample Size	Mean Age (Y)	Mean BMI (Kg/m ²)	Sample Size
Baroda (Present study)	12.12	17.35	443	12.43	18.08	324
Panagal(AP) 2009 (15)	--	--	--	14.04	20.6	223
Wardha 2006 (16)	13.40	16.88	420	12.61	15.54	344
Surat 2005 (17)	12.1	14.4	1092	11.8	15.4	1158
Gandhi 2004 (18)	14.69	18.01	2868	15.04	19.03	1883

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