

EB → Cont. to accumulation

Growth and Maturation of Sereer Adolescent Girls (Senegal) in Relation to Seasonal Migration for Labor

ERIC BÉNÉFICE,* CÉCILE CAMES, AND KIRSTEN SIMONDON
Institut de Recherche pour le Développement en Coopération, Laboratoire de Nutrition Publique, 34032 Montpellier Cedex 1, France

ABSTRACT This study compares the growth and maturity status of Sereer girls (Senegal) temporarily migrating to an urban setting during the dry season to work as maids in the capital city, Dakar, with girls remaining in rural communities. A total of 343 girls, aged 12.5–14.5 were surveyed: 222 lived year-round in several villages (sedentes) and 121 girls worked in Dakar for 8 months of the year (migrants). All girls were born and reared under the same conditions and in the same rural communities in Senegal. Growth and nutritional status were assessed with anthropometry, and the body mass index (BMI) was calculated. Sexual maturation was assessed by stage of breast development and occurrence of menarche. A questionnaire on housing conditions, food consumption patterns, nature of work, health status, and reasons for leaving the villages was administered to 57 urban girls. Overall, the girls were small relative to NCHS/WHO reference values: 30–40% were lower than –2 z-scores of age-specific medians. They also had less subcutaneous fat. Only nine girls had attained menarche and 30% were prepubertal in breast development. The migrants had a significantly higher body mass and BMI and thicker skinfolds than sedentes, but there was no difference in stature. The migrants were also more sexually mature than the sedentes. Comparison of anthropometric status 2 years before migration, in 1995, showed no differences between migrant and sedentes girls. Within migrant girls, those with two or more stays in Dakar were taller and heavier than newcomers. These results suggest that seasonal movement to the city results in improved nutritional status, as reflected in larger body mass and increased fatness. These factors appear to be associated with better living conditions in the city. *Am. J. Hum. Biol.* 11:539–550, 1999. © 1999 Wiley-Liss, Inc.

Interest in the health and nutritional status of adolescents in developing countries is rather recent (Kurtz, 1996). Adolescence begins with the appearance of earliest signs of sexual maturation and ends with the attainment of adult stature. In practice, the World Health Organization (WHO) considers individuals aged 10–19 years to be adolescent (WHO, 1986). This number comprises about 20% of the total population in the world, with 84% living in developing countries (Kurtz et al., 1994). In less developed countries, adolescents, especially girls, participate in daily domestic tasks in addition to agricultural work as needed. High rates of infectious and parasitic diseases and suboptimal nutrition add to their burden and may

contribute to later puberty (Satyanarayana and Naidu, 1979; Satyanarayana et al., 1989; Hussain et al., 1985; Aboye-Kuteyi et al., 1997; Kulin et al., 1982).

The issue of growth during puberty in Africa is of concern because the reproductive health of adolescent girls, and of their future infants, relies largely on the adoles-

Contract grant sponsor: Laboratoire de Nutrition Tropicale (LNP), Institut de Recherche pour le Développement en Coopération (Orstom); Contract grant sponsor: Nestlé Foundation.

*Correspondence to: Eric Bénéfice, Institut de Recherche pour le Développement en Coopération, 911 av Agropolis, BP 5045, 34032 Montpellier Cedex 1, France. E-mail: benefice@mpl.orstom.fr

Received 22 April 1998; Revision received 3 August 1998; Accepted 28 August 1998



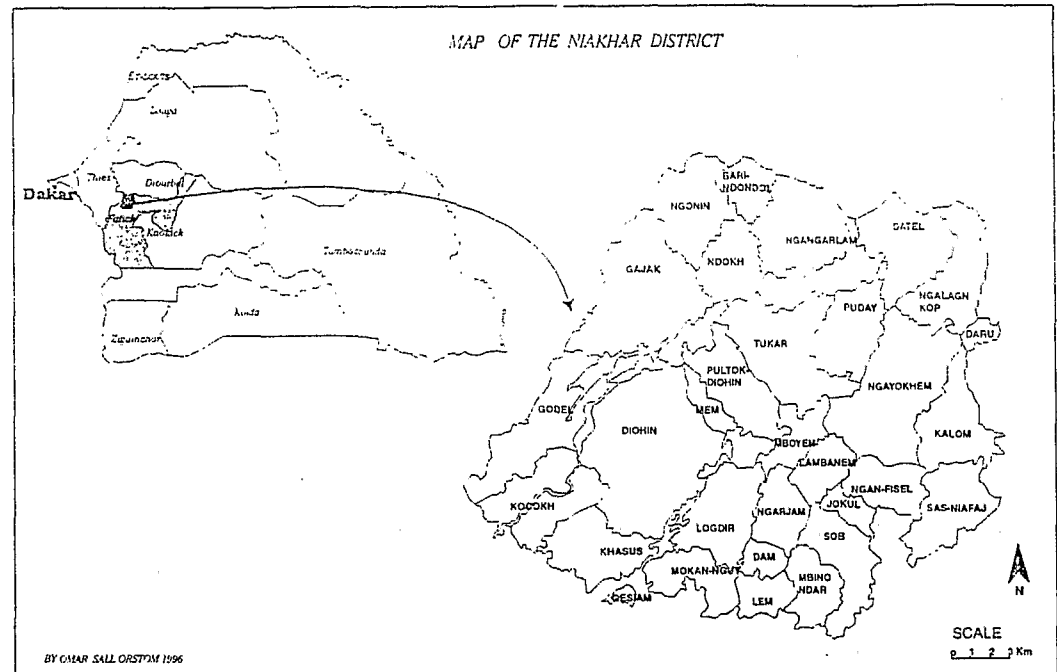


Fig. 1. Map of the Niakhar district.

cent's health before pregnancy (Brabin and Brabin, 1992). It has been shown in Jamaica, for example, that short mothers gave birth to thin, lightweight, and short babies (Thame et al., 1997). The nutritional risk is worsened in the case of adolescent pregnancy (Scholl et al., 1994). Adolescent pregnancy is common in West Africa because of the precocity of marriages.

In the developing countries, urban children generally have better growth and advanced maturation than do rural children (Cameron et al., 1992; Kulin et al., 1982; Corlett, 1986, 1988). This may be explained by better access to health services, education, and food. In the area under study, Niakhar, a rural district of Central Senegal, people often go to work in the capital city, Dakar, during the dry season. Girls as young as 10 years of age are often sent to Dakar to work as maids (Delaunay, 1994). Migrant girls tend to have a better nutritional status than that of sedentary girls (Simondon et al., 1997). However, it was not certain whether this improvement was due to living in the city or whether the nutritional status of girls was better before migration.

The aim of this study is first, to examine the growth and maturation of girls at the onset of puberty, and second, to study the influence of seasonal migration on growth status and sexual maturation.

ECOLOGICAL SETTING

Niakhar district is located in the so-called "peanut basin" of Senegal, about 150 km from the capital city of Dakar (Fig. 1). This area incorporates the historic territory of Siin, where an old agrarian civilization associated with herding and farming developed. The Sereer agrarian system is intensive and characterized by diversified food production on a rather limited space without fallow fields (Guigou and Lericollais, 1988). Cattle herding is still important. This region has a population of 28,000 inhabitants belonging mostly to the Sereer ethnic group. Ninety percent are farmers growing millet and peanuts during the rainy season (July to November). Since the 1970s, there has been a persistent dryness: the average annual rainfall decreased from about 720 mm to 450 mm. Undernutrition is prevalent in children aged 0–5 years: 5% have a weight-for-height of < -2 z-score of the

WHO/NCHS (WHO, 1983), and 20% have a height-for-age of <-2 z-score (Garenne et al., 1987).

Economic difficulties attributable to the persistent dryness, high population density (100–120 inhabitants per km²), and soil impoverishment, lead people—men, women, and children—to export their labor to the capital city in the dry season. Increasing numbers of adolescent girls are involved in the seasonal migrations. On the basis of a demographic census in 1992, 37% of 10- to 14-year-old girls have migrated for economic reasons (Delaunay, 1994).

LIVING CONDITIONS OF MIGRANT GIRLS IN DAKAR

About one-third of the girls enrolled in the present study ($n = 121$) were working in the city, and a subsample ($n = 57$) were relocated in the capital city and interviewed on reasons for migration and conditions of living. The decision to migrate was generally taken by parents, or in some cases by close relatives. However, 21 adolescents (37%) migrated on their own authority with family consent. The main reason for migration was economic. Thirty girls sent money to their families, but only 8 (14%) expected to assist their parents financially. The average number of seasonal migrations was 2.4; the length of stay varied from 1 to 10 months. A 1-month stay corresponded to the first experience in Dakar. An older adolescent or an adult woman, generally a family member or a close relation from the same village, was in charge of the girl in Dakar. As a rule, adolescents lived in the Sereer districts of the capital. Migration is managed by urban networks constituted of former migrants with ethnic and familial connections. These networks play an important role in integrating newcomers.

Adolescents shared a room with parents or girls from the same village to reduce the cost of living. In one-half of cases, girls lived in a shantytown in houses made of corrugated iron and cardboard. In less than one-half of cases, the house had running water and a toilet. Girls slept together in rooms not larger than 10 m². In one-fourth of cases, the housing was more comfortable; girls rented a room in an old building or in a shack. Finally, one-fourth of the girls had acceptable conditions of living with running water, latrines, and, in some cases, electric power; in that situation, only three to four

girls lived together. One-third of the girls interviewed had to pay a monthly rent equivalent to \$1.

The adolescent migrants worked as maids. Their job consisted of domestic tasks such as pounding, cooking, washing, and sweeping. They also had to care for children, to carry a baby on their back, or to run errands. The average working time was 10 hr/day, with a maximum of 16 hr/day, without any weekly rest day or holiday. However, only one-fourth of the adolescents considered their job more tedious than their usual tasks in the village. The average monthly wage was equivalent to \$8.5.

Adolescents were fed by their employer in the morning and at midday. They also brought a portion of the evening dish to be shared with their roommates. Foods most frequently cited were rice, millet or sorghum, manioc, fresh and dried fish, meat, vegetables, and palm and peanut oil. Snacking was frequent; more than one-half of the girls ate fruits, cakes, fritters, or water ices every day.

Most of the migrants came back to their villages during the rainy season (August and September) to help their families in the fields. They all come back to get married at about 18 years of age but, because women's activities in the fields or handicrafts are not lucrative enough, most will have to travel again to the capital during adulthood to sustain their families.

SUBJECTS AND METHODS

In 1983 and 1984, a growth and nutritional survey was carried out among all the 0- to 5-year-old children living in the Niakhar district (Garenne et al., 1987). Dates of birth were exactly known because a systematic birth date registration started in January 1983. Ten years later, in 1995, 1,120 of a total of 1,927 eligible girls were located and measured again (Simondon et al., 1997). The present study concerns the younger girls of that sample seen during infancy and in 1995, i.e., 406 adolescents aged 12.5–14.5 years. Girls were interviewed and examined at home. First, 221 nonmigrant girls were seen in March and April 1997; 64 migrant girls who returned to their villages for the religious ceremony of *Tabaski* (Muslim feast of *Aïd-el-Kébir*) were seen then; finally, 57 adolescents were located in Dakar and examined in May. The final sample was 221 sedentes and 121 migrants (Table 1).

TABLE 1. Sample size of Sereer adolescent girls by age group and migratory status

	Migrants	Nonmigrants	Total
13 yr	48	124	172
14 yr	73	97	170
Total	121	221	342

The adolescents were weighed barefoot with only a loincloth on an electronic scale, accurate to 100 g. Stature (in cm) was measured with a portable Harpenden anthropometer to 1 mm. Girls stood upright on a platform and looked straight ahead. Mid-upper arm circumference (MUAC)(cm) was measured after locating and marking the midpoint between the acromion and olecranon processes. MUAC was recorded to the nearest 0.1 cm on the left side with the arm relaxed. The triceps skinfold thickness (mm) was measured with an Holtain® caliper at the same site. The subscapular skinfold (mm) was also measured on the left side according to standard techniques (Lohman et al., 1988). Stature and skinfold thicknesses were measured two consecutive times and the means computed to reduce measurement variation. The same person performed all anthropometry with the help of a field assistant. Intraobserver technical error of measurement, defined as the square root of the squared differences of replicates divided by twice the number of pairs (Malina, 1995), was calculated in 33 subjects. It was equal to 0.19 cm for stature, 0.11 mm for the triceps skinfold, and 0.17 mm for the subscapular skinfold. These values were in the lower range of those reported in the literature (Lohman et al., 1988; Malina, 1995).

Body mass index (BMI)(kg/m²) was computed as weight/stature². Height-for-age (H-age) and weight-for-age (W-age) were expressed in standard deviation (z-score) from the WHO/NCHS (WHO, 1983). Values from the first National Health and Nutritional Examination Survey (NHANES I) were used for arm circumference (Frisancho, 1981) and skinfold thickness (Johnson et al., 1981). These reference values were used only for comparison and do not represent a goal or an ideal for Senegalese adolescents. Until now, the question of anthropometric standards is debated and WHO has not made a recommendation for this specific age group (De Onis and Habicht, 1996).

Sexual maturity was assessed by the development of the breasts (Tanner, 1962).

The same person performed the breast examination. In addition, adolescents were asked on the occurrence of menarche. Girls were regularly followed every 4 months since 1995 and were asked at each round whether they had experienced their first menstruation and when. When girls were unable to answer the question, their mothers were asked.

Girls were divided into two age groups according to their date of birth: 13 years (12.5–13.5, n = 172), and 14 years (13.5–14.5, n = 170). Statistical analyses were performed with the NCSS statistical software (Hintze, 1995). Chi-square, *t*-tests, analysis of variance (ANOVA), and multiple comparison tests were used.

RESULTS

Among 406 eligible girls, 342 (84%) were evaluated. Most of the 64 missing were migrants who did not come back to the villages during the Tabaski ceremony and who were not located in Dakar. A few families had moved out of the district.

Figure 2 represents the percentage of differences in anthropometry between Sereer adolescents and the reference medians. The Sereer adolescents show a marked deficit relative to the reference values. The mean difference is 12.2 kg at 13 years and 13.4 kg at 14 years. In both age groups, adolescent girls are 11.2 cm shorter than the reference medians. The triceps skinfold is 4 mm and the subscapular is 1.6 mm less than the reference medians. MUAC is 3.5 cm below the reference medians. As indicated in Table 2, there is a significant increase in anthropometric dimensions from 13 to 14 years of age.

Figures 3 and 4 compare the body mass and stature of the Sereer adolescents in this study with those of African girls of various origins. The Sereer girls have a similar mass and stature to that of a large group of mostly African girls of rural origin. They differ markedly from Kenyan and Senegalese urban girls (13 years) and from urban Senegalese (14 years). It should be noted that the urban Senegalese (Massé, 1969), as well as the urban Bantu (Kulin et al., 1982), belonged to well-off privileged households.

Sexual maturation of Niakhar adolescents as estimated from breast development is late: 39.3% of the 13-year-olds and 23.5% of the 14-year-olds are still prepubertal (stage I). Only 5.2% of 13-year-olds and

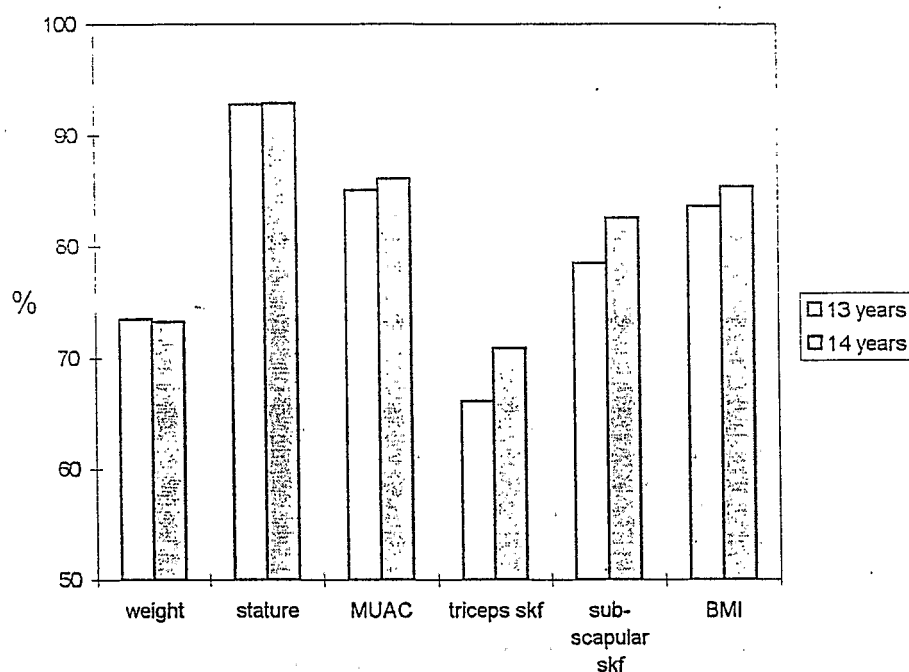


Fig. 2. Anthropometric characteristics of Sereer adolescent girls expressed as percentage of selected reference values.

TABLE 2. Anthropometric characteristics (means and standard deviations) of Sereer adolescent girls in two age groups

	13 yr (n = 172)	14 yr (n = 170)	t-test
Weight (kg)	33.9 ¹ 6.3 ²	36.9 6.1	4.5 0.0001 ³
Stature (cm)	145.9 7.6	149.1 7.2	4.0 0.0001
MUAC (cm)	20.7 2.0	21.7 2.2	4.4 0.0001
Triceps skinfold (mm)	3.8 3.7	10.0 4.1	2.9 0.004
Sub-scapular skinfold (mm)	6.6 2.1	7.6 2.4	3.7 0.0001
H-age (z-score)	-1.63 1.13	-1.63 1.0	0.003 ns
W-age (z-score)	-1.58 0.77	-1.62 0.74	0.59 ns
BMI (kg/m ²)	15.8 1.8	16.5 1.9	3.6 0.0001

BMI, body mass index; MUAC, mid-upper arm circumference; ns, not significant.

¹Mean.

²Standard deviation.

³P-value.

18.8% of 14-year-olds are in stage 4. Only 9 girls, all 14 years of age, are menarcheal.

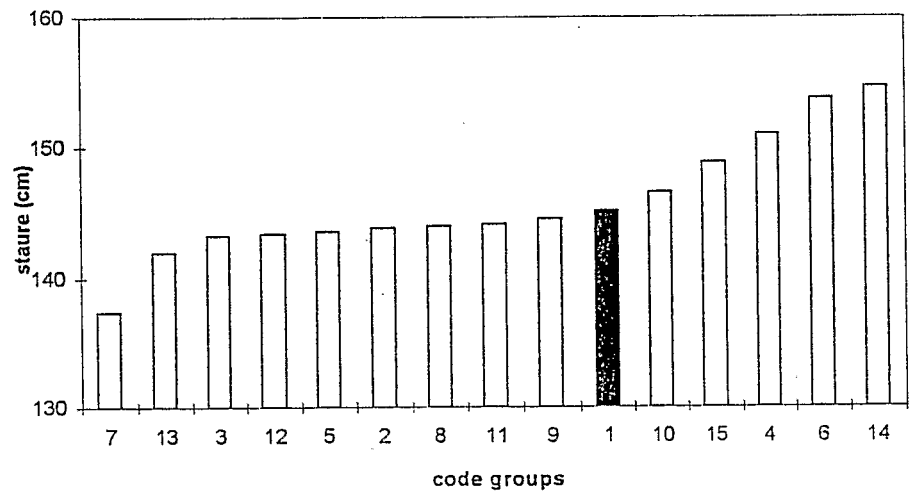
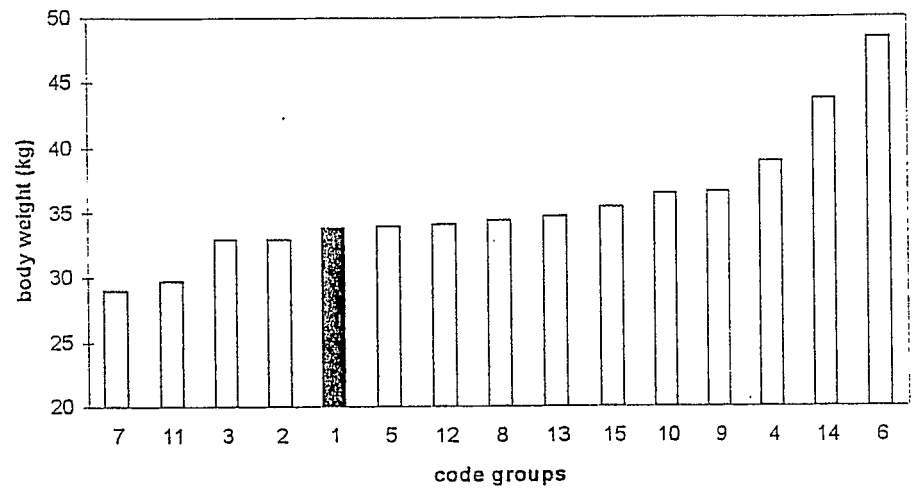
Table 3 shows that migrant girls are heavier than sedentes: 5.3 kg at 13 years and 3.8 kg at 14 years. The larger mass was

associated with a significantly greater MUAC and skinfold thicknesses, and BMI. However, migrants are not taller than sedentes.

There are no statistically significant differences in the mean H-age indices between the two groups. But 40% of the girls have marked stunting of growth with H-age <2 standard deviations (SD) of reference. By contrast, migrants had a significantly higher W-age with lower prevalence of W-age <2 SD: 10.4% in migrants vs 40% in sedentes, in 13-year-olds ($P < 0.001$), and 17.8% vs 48.6% in 14-year-olds ($P < 0.0001$).

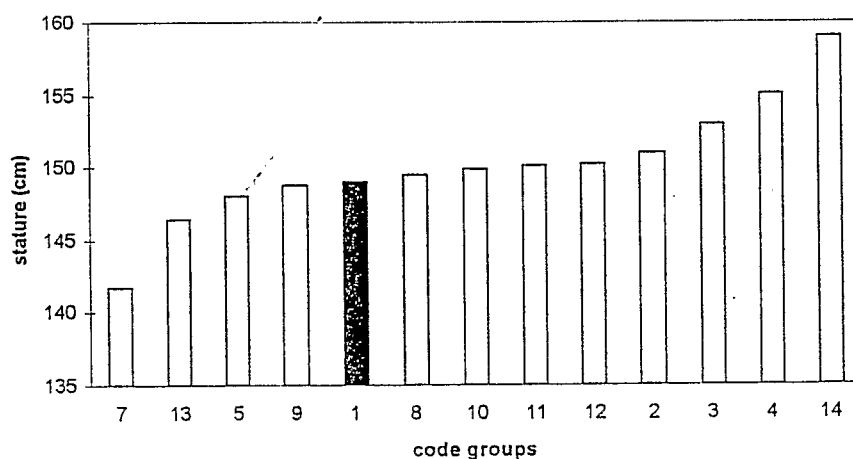
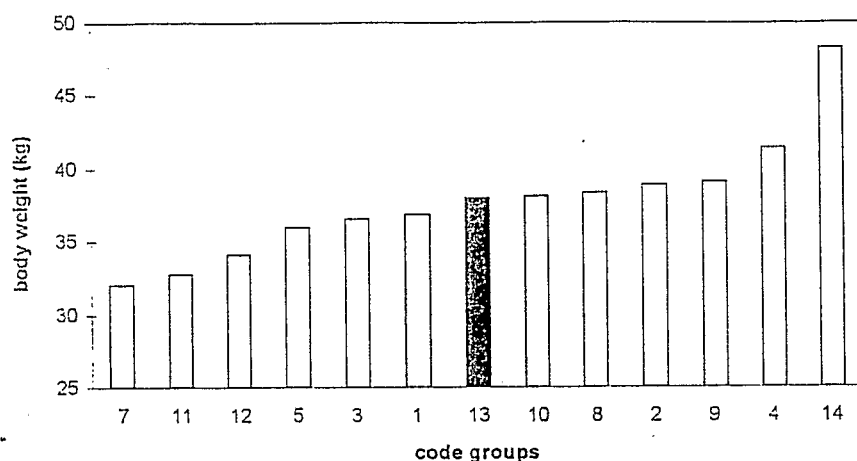
Migrant adolescents are also significantly more advanced in breast development (Fig. 5). Among 14 year-old-girls, 30% of sedentes are prepubertal, and only 12% were in stage 4. The situation is reversed in migrants. Only 4 of 121 migrants and 5 of 221 sedentes are menarcheal ($P = 0.39$, Fisher exact test).

A question of interest is whether migrants were in better nutritional condition before migration. If so, this may suggest that nutritional status was a criterion used by families to send girls to Dakar. The girls in this sample were measured in 1995 when



1. Present study
2. Sénégal rural, Serer (Simondon et al, 1997)
3. Sénégal rural, Wolof (Bénéfice and Malina, 1996)
4. Sénégal urban, Wolof (Massé et al, 1969)
5. Kenya rural, Kamba (Kulin et al, 1982)
6. Kenya urban, Bantu (Kulin et al, 1982)
7. Nigeria rural, Yoruba (Hussein et al, 1985)
8. South Africa, Tswana (De Villiers, 1987)
9. South Africa, urban Tswana (Corlett, 1986)
10. South Africa, rural Tswana (Corlett, 1988)
11. Kenya, Turkana (Little et al, 1983)
12. Namibia, Hottentot (Singer & Kimura, 1981)
13. The Gambia, Mandinga & Jola (Billewicz & McGregor, 1982)
14. NCHS, USA (Hamill et al, 1979)
15. Sénégal peri-urban, wolofs (Bâ, 1991)

Fig. 3. Body weight and stature of selected 13-year-old African girls.



1. Present study
2. Sénégal rural, Serer (Simondon et al, 1997)
3. Sénégal rural, Wolof (Bénéfice and Malina, 1996)
4. Sénégal urban, Wolof (Massé et al, 1969)
5. Kenya rural, Kamba (Kulin et al, 1982)
7. Nigeria rural, Yoruba (Hussein et al, 1985)
8. South Africa, Tswana (De Villiers, 1987)
9. South Africa, urban Tswana (Corlett, 1986)
10. South Africa, rural Tswana (Corlett, 1988)
11. Kenya, Turkana (Little et al, 1983)
12. Namibia, Hottentot (Singer & Kimura, 1981)
13. The Gambia, Mandinga & Jola (Billewicz & McGregor, 1982)
14. NCHS, USA (Hamill et al, 1979)

Fig. 4. Body weight and stature of selected 14-year-old African girls.

TABLE 3. Anthropometric characteristics of Sereer adolescent girls in two age groups, according to their migration status

	13 yr (n = 172)			14 yr (n = 170)		
	Migrants (n = 48)	Nonmigrants (n = 124)	t-test	Migrants (n = 73)	Nonmigrants (n = 97)	t-test
Weight (kg)	37.7 ¹	32.4	5.4	39.1	35.3	4.3
	7.2 ²	5.2	0.000 ³	5.5	6.0	0.000
Stature (cm)	146.9	145.6	1.07	149.0	149.2	0.13
	7.3	7.8	ns	6.8	7.6	ns
MUAC (cm)	22.2	20.0	7.02	22.7	20.9	6.1
	1.9	1.7	0.000	2.0	2.0	0.000
Triceps skinfold (mm)	12.0	7.5	8.4	12.2	8.4	6.7
	4.9	2.1	0.000	4.2	3.2	0.000
Subscapular skinfold (mm)	5.3	6.0	7.04	5.6	6.8	5.1
	2.8	1.4	0.000	2.3	2.2	0.000
H-age (z-score)	-1.54	-1.67	0.07	-1.64	-1.63	0.07
	1.08	1.15	ns	1.01	1.12	ns
W-age (z-score)	-1.14	-1.76	5.04	-1.33	-1.84	4.6
	0.83	0.67	0.000	0.68	0.71	0.000
BMI (kg/m ²)	17.4	15.2	7.2	17.5	15.8	6.5
	1.9	1.3	0.000	1.6	1.8	0.000

BMI, body mass index; MUAC, mid-upper arm circumference; ns, not significant.

¹Mean.²Standard deviation.³P-value.

they were 10 to 11 years old. A small proportion (n=72) had already begun their migratory cycle and were excluded from the comparisons. The anthropometric characteristics of 270 sedentary in 1995 were compared with those of girls who did or did not migrate in 1997 (Table 4). There was no age difference between the two groups, nor was there age interaction with other variables. The comparisons are thus presented in a single age group to simplify presentation. There were no differences in weight and skinfold thicknesses in 1995 between those who did and did not migrate in 1997. There also were no differences in nutritional indices and the BMI.

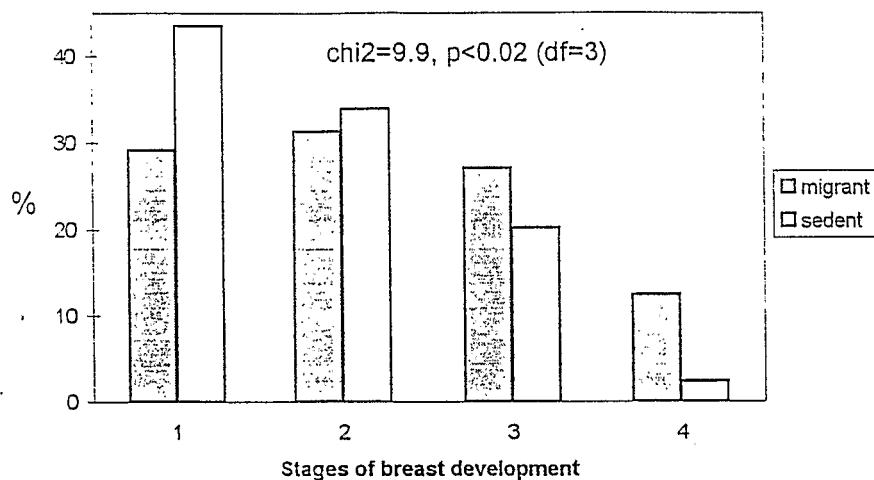
DISCUSSION

As a group, Sereer adolescent girls show growth and nutritional deficits. From data recorded in the same population 13 years ago, there is evidence of chronic and acute undernutrition in the communities: 23% have H-age indices of <-2 SD and 11% have weight-for-height of <-2 SD. Similarly, Hussain et al. (1985) in Nigeria found that undernutrition in early life is associated with a delay in the height and weight spurts at adolescence. Anthropometric characteristics of Sereer adolescents at the onset of puberty fit with those of African girls of rural origin (Fig. 3). Only urban girls from Senegal (Massé et al., 1969) and Kenya (Kulin et al., 1982) approach the NCHS median.

Growth retardation is associated with later sexual maturation. Only one-third of the adolescents show any breast development, though in European and North American populations, the median age at stage 2 is about 11 years (Malina and Bouchard, 1991). In Europe or North America, most 14-year-old girls have attained stage 4. Further, the number of menarcheal Sereer girls is very small: 9 of 342 girls (2.6%). Mean age at menarche in North American and European population ranges from 12.5 to 13.4 years (Malina and Bouchard, 1991). The trend in the present study confirms the finding of Simondon et al. (1997), which indicated a median age at menarche of 16.1 years of age in the same area, estimated with probit analysis. The cumulative effect of chronic undernutrition and poor conditions of living are probably the main factors explaining the later maturation. Satyanarayana and Naidu (1979), in Hyderabad (India), also found late menarche and shortness in previously undernourished girls.

Migration to the capital city is associated with a larger body mass, thicker skinfolds, and somewhat advanced breast development. Better nutritional indices in the urban compared with the rural setting have already been reported in Africa. In Botswana, Corlett and Woollard (1988) noticed that rural children were lighter but similar in stature to urban children. At the

13 year-old Senegalese girls



14 year-old Senegalese girls

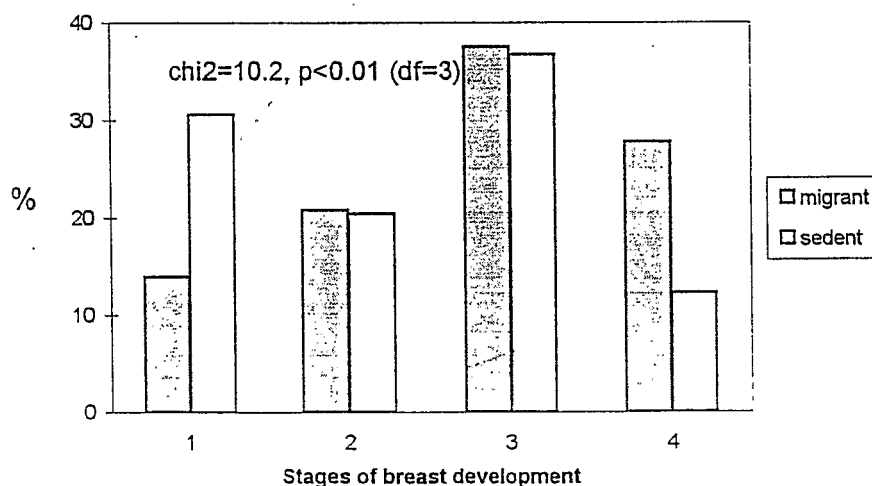


Fig. 5. Stages of breast development of migrant and sedentes Sereer adolescents.

onset of puberty in Kenya, advanced growth and maturation were noted among urban privileged girls compared with undernourished rural girls (Kulin et al., 1982). Well-off urban children from South Africa were larger and taller than rural children, although the differences were not always statistically significant (Cameron et al., 1992). In another study, Cameron et al. (1993) reported a significant advance in sexual development of urban youths. It must be empha-

sized that in the present study, all Sereer girls were raised in the same villages and thus exposed to the same environmental influences until the beginning of adolescence.

Interestingly, a gain in stature was not associated with migration. Similarly, there were no stature differences in urban or rural children from Botswana. Cameron et al. (1992) suggest that improvement in growth occurs when there is progress in health: better housing and sanitation standards. Fur-

TABLE 4. Anthropometric characteristics in 1995 of Sereer adolescent girls according to migration status in 1997 (after exclusion of 73 girls who had already begun to migrate in 1995)

Variable	Migrants in 1997 (n = 79)	Nonmigrants in 1997 (n = 191)	t-test
Weight (kg)	29.3 ¹ 6.7 ²	29.2 4.3	0.26 ³ ns
Stature (cm)	137.6 5.3	137.6 6.3	0.06 ns
MUAC (cm)	18.7 1.8	18.3 1.6	1.75 ns
Triceps skinfold (mm)	7.7 2.5	7.5 1.44	0.71 ns
Subscapular skinfold (mm)	5.8 1.6	5.7 1.4	0.9 ns
H-age (z-score)	-1.47 0.8	-1.43 0.9	0.3 ns
W-age (z-score)	-1.44 0.5	-1.45 0.6	0.07 ns
BMI (kg/m ²)	15.5 1.3	15.4 1.3	0.64 ns

BMI, body mass index; MUAC, mid-upper arm circumference; ns, not significant.

¹Mean.

²Standard deviation.

³t-value.

ther, advanced sexual maturity and good nutritional status are closely associated with higher socioeconomic status (Abioye-Kuteyi et al., 1997).

Living conditions in Dakar are, at best, suboptimal. A study of health characteristics of migrants from Niakhar to Dakar 20 years ago showed an improvement in food intakes and nutrition, but not in prevalence of infectious diseases (Benyoussef et al., 1973). However, living in Dakar brought relative physical and psychological comfort to the adolescents. Access to running water or health facilities was better. In the Niakhar area, there are only three poorly equipped health centers and three deep-drilled wells with safe water for 28,000 inhabitants. Information on food consumption patterns is not available, but it is likely to be the same as in Sereer groups of Central Senegal, where the diet is characterized by millet or sorghum as staple foods and rice as a secondary cereal. Consumption of meat is very uncommon, and fresh fish, milk, fruits, or vegetables are present only in small quantities. There are seasonal deficiencies in energy and protein, as well as in hemic iron, riboflavin, vitamin A, folate, and zinc (Chevassus-Agnes and Ndiaye, 1981; Rosetta, 1986). By contrast, adolescent maids are allowed to eat in their employers' homes

and may profit from more variety and better quantity of foods available (Benyoussef et al., 1973).

A somewhat controversial issue is related to possible catch-up growth during adolescence in previously stunted girls. Some studies show a higher gain in height during puberty (Galler et al., 1987; Dreizen et al., 1967; Sibrian et al., 1992). Other studies fail to demonstrate such an effect (Martorell et al., 1992). Satyarayana et al. (1981) showed that severely undernourished girls gained more height during puberty than normal girls, but without complete catch-up growth. It appears that the effect of undernutrition on growth is more pronounced before puberty and that height gain during puberty is not affected (Eveleth, 1985). The phenomenon of *compensatory growth*, which can occur after peak height velocity, has been described (Cameron et al., 1994). This is the case among Turkana pastoralists who continue growing into the late teens and early 20s (Little and Johnson, 1987). Most of these girls are prepubertal or just at the beginning of puberty. Further follow-up of the present sample would help to answer this question. The possibility of catch-up is certainly dependent on the living conditions. From this point of view, migrant girls, though being somewhat exploited by their employers, are less nutritionally at-risk than rural girls remaining with their family.

ACKNOWLEDGMENTS

We are grateful to adolescents and parents who participated in the study. Many thanks are due to our field assistants Ndeye Fatou Dieye, Moussa Sarr, and Etienne Ndong, and to Omar Sall research assistant of the Orstom. We are thankful to the two anonymous referees for their appropriate suggestions and comments. Many thanks to the editor-in-chief of the Journal for his kind assistance in editing the manuscript.

LITERATURE CITED

- Abioye-Kuteyi EA, Ojofeitimi EO, Aina OI, Kio F, Aluko Y, Mosuro O. 1997. The influence of socio-economic and nutritional status on menarche in Nigerian school girls. *Nutr Health* 11:185-195.
- Bâ A. 1991. Etude de l'état nutritionnel d'enfants sénégalais d'âge scolaire. Thèse de doctorat en médecine. Dakar: Université Cheikh Anta Diop. p 99.

- competition for nutrients. *Am J Clin Nutr* 60:133-188.
- Sibrian R, Delgado H, Delgado ME. 1992. Recuperación del retardo en talla en adolescentes desnutridos. *Arch Latinoam Nutr* 42:21S-26S.
- Simondon KB, Simon I, Simondon F. 1997. Nutritional status and age at menarche of Senegalese adolescents. *Ann Hum Biol* 24:521-532.
- Singer R, Kimura K. 1981. Body height, weight, and skeletal maturation in Hottentot (Khoikhoi) children. *Am J Phys Anthropol* 54:401-413.
- Tanner JM. 1962. *Growth at adolescence*. 2nd edition. Oxford: Blackwell Scientific.
- Thame M, Wilks RJ, McFarlane-Anderson N, Bennett FI, Forrester TE. 1997. Relationship between maternal nutritional status and infant's weight and body proportion at birth. *Eur J Clin Nutr* 51:134-138.
- WHO. 1983. *Measuring change in nutritional status*. World Health Organization: Geneva.
- WHO. 1986. *Young people's health—a challenge for society*. Technical report series No. 731. Geneva: World Health Organization.