GROWTH PROGRESSION AND MATURATIONAL TRENDS AMONG WARLI BOYS:
A TRIBAL POPULATION OF MAHARASHTRA, INDIA

ABSTRACT. — The study in physical growth and development confirms the fact that different body segments grow at different rates and times. This trend of growth is not only followed by the normal well-to-do children but even by undernourished and economically backward tribal children, the Warlis also following the similar norms of growth during this age range with certain variations.

Physical growth and development of children is widely recognized as a sensitive index of the health and nutrition of a population and as developing countries with poor nutrition and high infant mortality rates improve their health standards, growth studies become increasingly important in the evaluation of health care (Tanner, 1966). The knowledge of any change in growth pattern which occurs between one decade and the next is valuable evidence about the effectiveness, or otherwise, of status of the community (Marshall, 1977). The growth trends do not show much variation under normal conditions of nutrition but much depends upon the individual's socio-economic status. Most researchers have tried to evaluate and enumerate the trends of growth under different living conditions the world over, but the tribal populations have been paid little attention from the standpoint of health and general aspects of bodily development. The present study is devoted to evaluate the trends of growth in a tribal population of India, who not only are undernourished but also belong to the lower socio-economic strata of the society.

Data for the present study have been collected on the "Warlis", a tribal population inhabiting the Koshad hill area adjacent to the hilly tracts on the western coastline of Thana district of Maharashtra State, India. The total population of this area amounts to 0.884 million including 0.533 million tribals, who mainly subsist on agriculture (Census of India, 1971).

The main tribal groups inhabiting this area are — The Bhils, Warlis, Mahadev Kolis, Gonds, Kokans, Thakurs, Kalkaris, Gamits, Malhar Kolis, Dublas and the Dhodias.

The present study includes the "Warlis" only who have a total population of 0.29 million (Census of India, 1971). They not only lack in education but are also undernourished from the standpoint of health.

MATERIAL AND METHODS

The sample constitutes of 214 male Warli children, in the age range of 8 to 18 years, measured cross-sectionally for the following measurements: stature, body weight, sitting height, vertex, trunk height, head and neck length, total upper extremity length, total lower extremity length, biacromial breadth and bi-iliocristal breadth. Standard measurement techniques of Martin and Saller (1959) have been followed with necessary modifications according to I.B.P. handbook No. 9 (Weiner and Lourie, 1969).
The annual increase per year, i.e., the progression of growth, varies for different measures as it is minimum in case of body weight and maximum for stature (Table 3). The highest peak velocity (H.P.V.) occurs between 13-14 and 15-16 years for seven out of nine variables — stature (107.20 mm), body weight (20.99 kg), sitting height (66.32 mm), trunk height (56.69 mm), total upper extremity length (60.50 mm), bi-bi-terrestrial breadth (38.83 mm) and bi-terrestrial breadth (27.15 mm). The total lower extremity length (67.67 mm) and head and neck length (5.56 mm) are the lowest peak velocity of H.P.V. between 12-13 and 14-15 years, which is earlier by one year than the rest of the seven variables (Table 2).

Table 3. Percentage of Growth achieved at each age of its final value index at 18 years for all the nine variables

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Height</th>
<th>Body Weight</th>
<th>Sitting Height</th>
<th>Trunk Length</th>
<th>Head and Neck Length</th>
<th>Total Upper Extremity Length</th>
<th>Total Lower Extremity Length</th>
<th>Bi-bi-terrestrial Breadth</th>
<th>Bi-terrestrial Breadth</th>
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<tr>
<td>8-9</td>
<td>72.92</td>
<td>42.43</td>
<td>74.64</td>
<td>70.91</td>
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<td>71.47</td>
<td>73.06</td>
<td>71.43</td>
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<td>9-10</td>
<td>75.96</td>
<td>45.10</td>
<td>77.83</td>
<td>73.72</td>
<td>84.34</td>
<td>74.58</td>
<td>75.76</td>
<td>74.58</td>
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<td>10-11</td>
<td>76.48</td>
<td>47.56</td>
<td>79.24</td>
<td>77.75</td>
<td>84.84</td>
<td>77.57</td>
<td>78.65</td>
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<td>78.11</td>
<td>50.34</td>
<td>80.75</td>
<td>79.95</td>
<td>83.82</td>
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<td>57.84</td>
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<td>71.37</td>
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It is obvious yet essential in understanding the increase in trunk and leg segments to observe that for different segments of body, maturity comes at different points. As a general phenomenon, the rate of growth not only varies from one child to another but also within one individual child as well. This variation is attributed to the fact that growth and differentiation do not take place at the same rate and time in constituent components of the body. Thus, we often observe that the head and trunk segments inflate in size more due to the increase in the size of trunk segment than in leg segment or head and neck segment during adolescence (Tanner, 1962; Nath, 1971, 1972). This differential trend in the segmental growth is mainly responsible for early and late occurrence of adolescent growth spurt. The highest peak velocity (H.P.V.) in different segments may occur during the same period on one hand while on the other different segmental may show variation of time in the occurrence of H.P.V.

The occurrence of peak velocity in different segments is influenced by several factors: genetics, nutrition, hormonal factors, and other environmental factors. Genetic factors play a significant role in determining the timing of peak velocity. Nutrition is another important factor that influences peak velocity. Adequate nutrition is crucial to support adequate growth and development. Hormonal factors, particularly the growth hormone, are also key regulators of peak velocity. Environmental factors, such as social and economic conditions, can also impact peak velocity.
modal) velocity curves among Jat boys of Meerut, U.P. (India) belonging to a somewhat similar socio-economic strata of society as that of the Warlis, with certain differences in their nutritional intake. The increased sample size per age group could have provided us some alternative situation but collection of larger sample size was not possible.

Sitting height vertex, which is constituted of trunk segment (trunk height) and head and neck segments, attains H.P.V. between 13-14 years along with stature, body weight, upper extremity length (arm segment), biacromial breadth and bi-humeralian breadth. But among the two constituent segments of sitting height vertex, head and neck segment attains H.P.V., along with sitting height vertex a year later than the head and neck segment. This discrimination in attainment of H.P.V. in the two constituent segments highlights the fact that the rate of head and neck segment in growth of total stature is more during the period of pre-adolescence along with the leg segment while the spur in stature is more due to the increase in trunk segment than to the leg segment or head and neck segment.

The second peak velocity for sitting height vertex occurs between 16+ and 17+ years while the two constituent segments again show a reverse discrimination, i.e., trunk segment attains second peak velocity earlier by a year, i.e., between 15 and 16 years while the sitting height vertex whereas the head and neck segment attains it a year after trunk segment along with the sitting height vertex. This situation is reverse of what is observed during the occurrence of H.P.V. This substantiates the fact that the trunk, the head and the neck are at different stages of development. The two other constituent segments of stature, i.e., the trunk and the leg, have attained their adult growth percentage at age 17+ while the head and neck segment is yet to achieve 0.88 percent of growth at this age in contrast to 0.98 percent and 0.93 percent in case of trunk and leg segments respectively. It may be deduced from this analysis that the increase in stature beyond the age of 17 is mainly due to the increase in the head and neck segment.

The two transverse breadths of the trunk segment, i.e., the biacromial breadth and the bi-humeralian breadth, show the occurrence of adolescent spur (H.P.V.) between 13+ and 14+ years along with other linear measures among Warli boys except the head and neck segment and the leg segment (Table 2). The occurrence of second peak velocity for both of these variables is recorded between 15+ and 16+ years. This phenomenon of occurrence of second peak velocity is simultaneously recorded between 15+ and 16+ years for the height of trunk segment and arm segment. It would be interesting to note here that the two variables trend in the trunk segment show the occurrence of adolescent spur (H.P.V.) and the second peak velocity (post adolescent spur) pointing out, the fact that the different parts of the trunk segment follows a similar pattern in attainment of adolescent spur segment simply because the fact that sitting height vertex is composed of two successive segments, i.e., head and neck segment, and trunk segment, and the delay in occurrence of second peak velocity is because of the head and neck segment mainly, which attains second peak velocity a year after between 16+ and 17+ years along with the leg segment, stature and body weight.

The maturational direction of the constituent segments of stature among the Warli boys follows a cephalo-caudal gradient of growth at age 8+ where the head and neck segment achieves 83.41 percent of growth as compared to the trunk segment (70.01 percent) and leg segment (72.06 percent). But on assessing the trunk and leg segments at the same age, a reverse gradient of maturation seems to be operative, i.e., leg segment achieving 73.06 percent of growth is ahead of the trunk segment (70.01 percent) at age 8+. This reverse situation of the maturation has been referred to as caudal-cephalic gradient of growth (Nath, 1975). Thus, it may be elucidated here that cephalo-caudal gradient is operative between head and neck segment and trunk segment but trunk — leg gradient is reverse, i.e., caudo-cephalic at age 8+ within the stature. This clearly indicates a differential trend of growth within the constituent segments of stature.

Further, it is observed that the trunk — leg maturity gradient follows a cephalo-cephalic direction of maturation of each age from 8+ to 17+ years while head and neck — trunk gradient follows a cephalo-caudal direction up to age 15+ whereas caudo-cephalic gradient is operative up to age 17+ (Table 3).

The arm — leg maturity gradient also follows a cephalo-caudal maturational direction indicating an advanced maturity of leg segment at each age from 8+ to 17+ over the arm segment. While considering sitting height vertex (as combination of head and neck and trunk segments) — leg gradient a mixed direction of maturation is observed, as at age 8+ the maturation follows cephalo-caudal progression but from age 9+ onward till age 17+ the maturational direction follows a reverse progression, i.e., caudo-cephalic. The emergence of this mixed trend, due to the head and neck component of sitting height vertex, is indicative of advanced maturity of leg segment over the sitting height vertex from age 9+ onwards.

The two transverse dimensions of trunk, i.e., biacromial breadth and bi-humeralian breadth, show that biacromial breadth is more advanced in maturity at each age over the bi-humeralian breadth. This advanced maturity of biacromial breadth indicates a cephalo-caudal progression at each age between the two transverse measures of trunk segment.

Observations on percentage of growth achieved between 9+ and 17+ years elucidate the fact that body weight shows maximum increase amounting to 27.13 percent, while the increase in other measures does not exceed beyond 31 percent — bi-humeralian breadth (30.88 percent), trunk height (29.01 percent), biacromial breadth (28.50 percent), upper extremity length (28.62 percent), lower extremity length (28.52 percent), lower extremity breadth (26.91 percent), stature (27.60 percent), sitting height vertex (25.59 percent). The head and neck segment shows minimum increase of only 15.16 percent within this age range. This variation in the percentage of growth achieved by different segments, once again, confirms the basic fact of growth trends that different segments grow at different rate at time. This trend of growth is not only followed by the normal well-to-do children but even by undernourished and economically backward tribal children, the Warlis, also following the similar norms of growth during this age range with certain variations.

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Subrata Nath, Bapi Thirag Department of Anthropology, University of Delhi, Delhi — INDIA