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## **Growth-and-Obesity Enhanced-Roadmaps of Children**

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‘Growth-and-Obesity Profiles’ of a family were first introduced in 2011 in a paper describing KJK (Kamal-Jamil-Khan) Model. To compute parents’ obesity profiles, gender-specific heights and masses read from extended tables (<http://www.ngds-ku.org/Papers/J34.pdf>), containing heights and masses corresponding to 0.01<sup>th</sup>, 0.1<sup>th</sup>, 1<sup>st</sup>, 99<sup>th</sup>, 99.9<sup>th</sup> and 99.99<sup>th</sup> percentiles, were used to interpolate, linearly, percentiles of heights and masses of father and mother using age-20 values. Either parent was suggested to gain mass corresponding to the difference obtained by subtracting net mass from optimal mass, if the value of later exceeded the former. Net mass was estimated by subtracting clothing correction from ‘gross mass’, which was obtained when the individual was weighed wearing indoor clothing. In case, value of optimal mass was lesser than net mass, father was advised to reduce mass corresponding to that difference, if the value did not exceed 10 kg, otherwise he should lose 10 kg within the next 6 months — kg stands for kilogram(s). For mothers (currently married or recently divorced/widowed), the recommended suggestion to reduce mass was computed by adding 5 kg to gross mass, to account for possible pregnancy and the resulting fetal mass. For males and females up to the age of 30 years, optimal mass (first mention on page 710 of <http://www.ngds-ku.org/Papers/J26.pdf>; rigorous definition on page 89 of <http://www.ngds-ku.org/Papers/J29.pdf>) was taken as the mass corresponding to height percentile. Above that age, BMI (body-mass index) was taken as reference and optimal mass was computed by multiplying square of height with the ideal BMI value (24 kg/m<sup>2</sup>). Estimated-adult BMI was computed by dividing estimated-adult mass in kg by square of estimated-adult height in m (page 239 of <http://www.ngds-ku.org/Papers/J30.pdf>) — m stands for meter(s). This may be interpreted just like BMI for adults and its numerical value provided a snapshot of obesity status of child as a grown-up adult. Procedures used for obtaining percentiles of parents’ heights were, also, adapted to compute percentiles of target height (adult-mid-parental-height) for son or daughter. Child’s percentile of height (mass) was computed by first calculating height at the given age using the technique of box interpolation. Optimal mass was computed using constant-age route and, subsequently, used to find obesity profile. A similar procedure was adopted to compute current-age-mid-parental height. To determine whether the child was tall or stunted, the incumbent’s height was compared with gender-specific-mid-parental height at current age. To generate ‘Growth-and-Obesity Enhanced-Roadmaps’ of sons or daughters (generalization of ‘Growth-and-Obesity Roadmaps of Children’ <http://www.ngds-ku.org/Presentations/Roadmap.pdf>), more than one profile was listed (each profile representing a checkup), and recommendations were included to gain height and acquire or lose mass (weight), to be generated from the most-recent profile. 3 height values were compared — measured height, current-age-mid-parental height and army-cutoff height. Maximum value of set of the above 3 values was taken as reference and optimal mass, after 6 months, was computed based on the estimated-reference height (6 month ahead in time scale). Difference of measured mass (current value) and optimal mass (after 6 months) might be taken as guideline to set targets to lose (gain) mass within the next 6 months, if the value was positive (negative). Month-wise recommendations to pick up height or gain (lose) mass were prepared, taking care of the principle that a child should not be required to lose more than 10 kg within the next 6 months, in order to avoid any adverse health effects from a rapid loss of mass. These enhancements were incorporated in the growth-and-obesity software (SOFT-GROWTH), which is being tested to generate reports for the students of a local school, participating in the study. Illustrative examples of ‘Growth-and-Obesity Enhanced-Roadmaps’ for a wasted and an obese child appear in **Additional File** (uploaded at the address [http://www.ngds-ku.org/Presentations/Enhanced/Additional\\_File.pdf](http://www.ngds-ku.org/Presentations/Enhanced/Additional_File.pdf)). The method proposed and the associated software may help nutritionists, pediatricians, sport coaches and others, involved in the health and the well being of children, to plan an efficient and an effective course of intervention to prevent stunting, wasting and obesity in the next generation of Pakistan.

**Keywords:** Growth modeling, mid-parental height, army-cutoff height, optimal mass, *estimated-adult* BMI

**Conflict of Interest Statement:** No potential conflict of interest is identified for this work

**Research Ethics:** Project initiated after Institutional Review Process and conducted in compliance with ethical and human-right standards in our region.

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