



**STUNTING INDUCED BY WASTING – WASTING INDUCED BY  
STUNTING: A CASE STUDY OF J. FAMILY  
(PROJECT PROTOCOLS AND MODEL)**

**SGPP-KHI-20060412-01**

*Syed Arif Kamal, Samira Sahar Jamil and Urooj A. Razzaq*



**Additional File 1**

**Table of contents**

Box 1. Laboratory techniques	02
Box 2. Project protocols	03
Box 3. Model development I	04
Box 4. Model development II	05
References I	06
References II	07

**Box 1. Laboratory techniques**

Heights, masses and mid-upper-arm-circumferences (MUACs) were measured to accuracies of 0.1 *cm* and 0.1 *kg*, according to laid-down procedures [1], briefly described here. Child was required to undress to short underpants, all clothing above the waist, shoes, socks and accessories removed. For measuring stature, the child was aligned to mounted-engineering tape and instructed to keep hands straight and open, palms touching thighs, holding breath. A pencil was held at eye level so that head remains straight. Height was recorded to nearest 0.1 *cm* by placing setsquares on engineering tape. Mass was recorded to nearest 0.1 *kg*, using standard beam scale. Child was asked to step on scale with empty hands, standing in the center, looking straight and holding breath. At the beginning of each measurement session, equipments were calibrated using a standard 100-*cm* ruler and a standard 2-*kg* mass. MUAC was measured to accuracies of 0.1 *cm*, on both right and left arms. The child was seated on stool, wooden planks placed under the feet to make sure that child's thighs were making angles of 90<sup>0</sup>, both with the lower leg (from knee-to-shin) and the upper torso (neck-to-hip). Hand (shoulder to elbow portion) was aligned with the upper torso and palms resting on thighs [1]. Father's (Mother's) mass was 'gross mass', converted to 'estimated-net mass' ('net mass' is defined as mass without any article of clothing worn) by subtracting a suitable clothing correction. Child's recorded mass was close to 'net mass' (as the child was allowed to wear only briefs or panties) and used without any clothing correction.

Children were, also, screened for factors, which may contribute to growth retardation. These included anemic conditions, cardiac diseases and spinal curvatures, specially, scoliosis, kyphosis and lordosis. Visual inspections of back in anatomical and mild-stretching positions, Adam's forward bending test and moiré fringe topography were employed to detect spinal curvatures.

## Box 2. Project protocols

The NGDS (National Growth and Developmental Standards for the Pakistani Children) Pilot Project was initiated in 1998, taking into account of North American and European ethical and human-right standards [2], after ‘Institutional Review Process’ by University of Karachi authorities, which included committees of Chancellor (Governor Sindh) and Vice Chancellor. SGPP (Sibling Growth Pilot Project) is a subproject of the NGDS Pilot Project, in which family members are weighed and measured at SF-Growth-and-Imaging Laboratory. Participation is according to ‘Opt-in Policy’ adopted through ‘Informed Consent Form’ [3], which includes website address [4] (this website contains information and photographs of procedures). Both parents signed the form and received detailed instructions to prepare children for checkups so as to maintain standardization of procedures. All measurements were carried out before noon, parents in minimal indoor clothing, children completely undressed except for briefs or panties, everything else removed, including accessories, with parents present. Everyone removed shoes and socks. Privacy (acoustic and visual), confidentiality and comfort of the participants were maintained [1]. Parents were able to discuss ‘Growth-and-Obesity Profiles’ with the Project Director.

**Box 3. Model development I**

A mathematical-statistical model was developed to study the case of J. Family. According to Kamal, Firdous and Alam [5], height and mass graphs were assumed to be linear, for measurements performed 6-month apart. This was a good approximation almost everywhere. Exceptions are regions, where there was a rapid change of growth rate, for example, from infancy-to-childhood phase, and childhood-to-puberty phase. Other than these transition regions, linear interpolation was employed to compute height at some age grid (9.0, 9.5 years, etc.). Boy's (Girl's) target height (in *cm*) was computed by adding (subtracting) 6.5 *cm* to (from) average height (*cm*) of biological parents [6, 7]. In the absence of availability of Pakistani growth charts at the time of examinations, target height was supposed to be the best estimate of family-growth patterns [8]. This computed height was extrapolated backwards to compute desired height at a given age grid and compared with interpolated-actual height at the same age to determine whether the child was *stunted* (short-for-age) or *tall* for age. Body-mass index (*BMI*) was computed by taking ratio of mass (in *kg*) to square of height (in *meter*). For adults, *BMI* was compared with the reference value (for the region) to determine, roughly, if an adult was *obese* (excess mass-for-height) or *wasted* (lesser mass-for-height). For children, *BMI* interpretation was different from adults, as there is no fixed range, which could be used to label children possessing excess (lesser) mass-for-height. *BMI* tables have been prepared for the younger population. Percentiles, read off from *BMI* tables for boys (girls), indicated whether a child was *obese* or *wasted*. Kamal and Jamil [7], recently, put forward the idea of *estimated-adult BMI*, ratio of estimated-adult mass to square of estimated-adult height. This parameter could, roughly, predict obesity status in adulthood. For a better estimate, optimal mass (mass, corresponding to height percentile) for given height was determined and compared with actual mass to find out whether child was *obese* or *wasted*.

For the purpose of computing 'Growth-and-Obesity Moving-Profiles', presented here, this model has been, slightly, modified. The word 'moving profile' was taken from statistical terminology 'moving average', and propagates the extended concept of profile from the 'snap shot' health status to a 'time series' giving 6-month average. The physicians, these days, are more interested in these types of indicators, for example, blood glucose of a patient, fasting and random, is not as reliable as HbA<sub>1C</sub>.

**Box 4. Model development II**

The concepts of growth (height) velocity and rate of mass gain (loss) were replaced by height and mass percentiles. A jumping up (down) on height- or mass-percentile curve would indicate height or mass gain (loss). For height or mass values low enough to correspond to a percentile below 3<sup>rd</sup>, logistic regression or, at times, linear interpolation was used to compute a numerical value of such percentile. Single-checkup-growth profile (for the final checkup) was computed using KJK (Kamal-Jamil-Khan) model [6]. ‘Growth Tables’ [7], obtained from ‘Growth Charts’ [9], were used to compute growth-and-obesity profiles. These charts are, actually, meant for assessment of US population, but are being employed in other countries, where growth-and-obesity standards are not, yet, developed. These profiles were used to evaluate the success of diet, exercise and lifestyle-adjustment plans [10]. The method is general, and it can be used for other populations, too, provided the dataset is replaced with population-representative growth tables.

## References I

- 1 Kamal SA. Manual for obtaining anthropometric measurements. Karachi: 2006; full text:  
[http://www.ngds-ku.org/ngds\\_folder/M02.pdf](http://www.ngds-ku.org/ngds_folder/M02.pdf)
- 2 Kamal SA, Alam SJ, Firdous S. The NGDS Pilot Project: Software to analyze growth of a child (a telemedicine perspective). *National Telemedicine Conference Pakistan 2002*, Technology Resource Mobilization Unit (TreMU), Ministry of Science and Technology, Government of Pakistan, Islamabad (Pakistan), June 2002: 2; full text: <http://www.ngds-ku.org/Papers/C52.pdf>
- 3 Informed Consent Form required to participate in SGPP (Sibling Growth Pilot Project):  
[http://www.ngds-ku.org/SGPP/SGPP\\_form.pdf](http://www.ngds-ku.org/SGPP/SGPP_form.pdf)
- 4 The NGDS Pilot Project: Aiming at the future of Pakistan — NGDS stands for *National Growth and Developmental Standards for the Pakistani Children*; a community-based project dealing with child growth and optimal-weight management of families, URL: <http://ngds.uok.edu.pk>
- 5 Kamal SA, Firdous S, Alam SJ. An investigation of the growth profiles of Pakistani children. *Int J Biol Biotech* 2004; **1**: 709-717, full text: <http://www.ngds-ku.org/Papers/J26.pdf>
- 6 Kamal SA, Jamil N, Khan SA. Growth-and-obesity profiles of children of Karachi using box-interpolation method. *Int J Biol Biotech* 2011; **8**: 87-96, full text:  
<http://www.ngds-ku.org/Papers/J29.pdf>
- 7 Kamal SA, Jamil SS. A method to generate growth-and-obesity profiles of children of still-growing parents. *Int J Biol Biotech* 2012; **9**: 233-255, full text: <http://www.ngds-ku.org/Papers/J30.pdf>

## References II

- 8 Tanner JM, Goldstein H, Whitehouse RH. Standards for children's height at ages 2-9 years allowing for height of parents. *Arch Dis Child* 1970; **45**: 755-762
- 9 Growth Charts have been published on the website of Centers for Disease Control, Atlanta, GA, United States: <http://www.cdc.gov>
- 10 Kamal SA, Rajput MK, Khan SA. 3-D-optical imaging in diabetic foot care of children. *Symposium on Diabetic Foot Care*, November 19, 2011; Department of Orthopaedic Surgery, Jinnah Postgraduate Medical Centre, Najmuddin Auditorium, JPMC, Karachi, 1, abstract:  
<http://www.ngds-ku.org/Presentations/JPMC.pdf>

*Web address of the main document:*

**STUNTING INDUCED BY WASTING — WASTING INDUCED BY STUNTING:  
A CASE STUDY OF J. FAMILY**  
<http://www.ngds-ku.org/Papers/J32.pdf>

*Web address of this document:*

**Additional File 1: PROJECT PROTOCOLS AND MODEL**  
[http://www.ngds-ku.org/Papers/J32/Additional\\_File\\_1.pdf](http://www.ngds-ku.org/Papers/J32/Additional_File_1.pdf)