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A METHOD TO GENERATE GROWTH-AND-OBESITY PROFILES OF CHILDREN OF STILL-GROWING PARENTS[¶]

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ABSTRACT

This work presents the method of computing growth-and-obesity profiles of children of still-growing parents (under-21 father and under-19 mother). The method for generating growth-and-obesity profiles of children of grown-up parents cannot be employed for the children of young spouses, as it is based on values of adult height of both parents. In the present scenario, adult height is not available as the parents are still growing. This work modifies the box-interpolation-based model to produce growth-and-obesity profiles of such families. This is accomplished by computing estimated-adult heights of both parents, using the percentiles of their current heights. These values are, then, utilized for the computation of adult-mid-parental (target) heights. This model estimates adult heights and weights of all the family members and expresses as percentages, the degrees to which the individuals are obese (wasted), taking optimal weights as standard. For children, this method, also, provides the information if the incumbents are tall (stunted), based on current-age-mid-parental heights. This procedure is demonstrated through simulated data with an example of a young couple and their twin children. This framework can be adjusted for families, in which, one of the parents is still growing, while the other one has attained adult height. Extreme cases presented earlier have been enhanced and concept of *estimated-adult BMI* (body-mass index) for children introduced. This index could be used to, roughly, classify a child as obese or wasted. Sociological and psychological implications of underage marriages are, also, looked into.

Keywords: Box interpolation, growth modeling, optimal weight, adult-mid-parental height, estimated-adult height, estimated-adult *BMI*

INTRODUCTION

Mau Zi Tung transformed the large population of China from *liability* to *asset*. This became possible by grooming the nation, systematically, to prepare them mentally, physically, emotionally and morally so that they can take up their assigned tasks and responsibilities efficiently and effectively. In Pakistan, we have not been able to provide basic health care to our children. With obese, stunted and malnourished children, we should expect the national image to further deteriorate in future. Parents, teachers and counselors have expressed great interest in knowing growth-and-obesity profiles of their children (Kamal *et al.*, 2011*b*), which included estimated-adult heights and weights of their sons or daughters, in order to maintain optimal weight-for-height through exercise and diet programs.

According to Zverev and Chisi (2005) height is the best indicator of body size. Body-size estimates such as height and weight are required for assessing the status of children's growth and nutrition. Height may be estimated from arm span by using regressional techniques or fixed-correction factors. Barker *et al.* (2005) have analyzed growth patterns of children, who suffered from coronary heart disease as adults. Efficiency of growth-hormone treatment in increasing adult height has been investigated by Cuttler and Rosenfield (2011), Duché *et al.* (2008), Haffner *et al.* (2000), Hintz *et al.* (1999), Quigley *et al.* (2005) and Ross *et al.* (2011). Yanovski *et al.* (2003) reported treatment with a Lutenizing hormone in adolescents having short stature. Kapur *et al.* (2005) have studied effect of dietary intake on stature of Indian children.

Prevalence of obesity is of prime concern to health-care professionals, because certain medical conditions (type II diabetes, hypertension, osteoarthrirtis) are well related to excess body weight (S. Z. Yanovski and J. A. Yanovski, 2011). Dietz *et al.* (2005) have given strategies for treatment and prevention of overweight and obese children as well as adolescents. Palfery (2009) is of the opinion that prevention is cost effective, since childhood-preventive care

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[¶]The italic superscripts [a], [b], [c], …, appearing in the text, represent endnotes listed before references.

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Fig. 1*a*, *b*. Height and mass of a boy measured in SF-Growth-and-Imaging Laboratory

for obesity may help avert serious conditions in adulthood. Nestle (2006) mentions key policy actions recommended to encourage children to eat more healthfully. Mozaffarain *et al.* (2011) have discussed effectiveness of different food items to maintain proper weight. These include ban on using cartoon characters, endorsements by celebrities, food packages making health claims, marketing (in schools, stealth), media literacy, improvement in school meals combined with consumption of fruits and vegetables. Weiss *et al.* (2004) have determined that there is high metabolic-syndrome prevalence among children suffering from obesity. S. Z. Yanovski and J. A. Yanovski (2011) are of the opinion that advances in energy-balance understanding would, subsequently, contribute to discovering better treatments for obesity. The incidence of childhood obesity has increased, mainly, because of lack of physical activity (Christodoulos, 2006). Ludwig (2007) has described long-term effects of obesity epidemic in 4 phases. Phase I, from 1970 till now, has increasing cases of obesity due to lack of awareness of its adverse effects. In the years to come, Phase II would emerge with serious medical conditions as type-II diabetes, fatty lever and many psychosocial problems. In Phase III, the situation would, further, complicate and life-threatening diseases, like coronary heart disease, kidney failure and many more would increase mortality rate and shorten life expectancy of American population. In Phase IV, the prevalence of weight-related diseases would accelerate more resulting in non-genetic influences in the offspring, if this trend continues. In an e-communication to Rafia Imtiaz[a], Ludwig explained: “Phase IV of the epidemic would develop slowing over time, as obese children grow up and give birth to the next generation of children.” Kamal *et al.* (2011*b*) have, also, indicated that obese parents have a greater chance of having obese children, probably, because of family-dietary habits. Ramzan *et al.* (2008) have reported body-mass status of 1336 students (6-11-*year* old, 865 boys, 471 girls, from 8 primary schools) in Dera Ismail Khan, KP, Pakistan. They have found out that both under- and over-nutrition are present in the study population, more mal-nourished girls than boys. Kamal *et al.* (2011*a*) have done a preliminary study to assess prevalence of obesity in BS (Final Year) students of University of Karachi.

Obesity and stunting are, now, well identified as indicators of poor health and nutrition in childhood. However, in order to address these problems, proficiently, one needs to have an objective and a quantifiable standard to determine severity of obesity and stunting. Kamal *et al.* (2011*b*) have worked out such a criterion, introducing just one word (*obese* with a number indicating the degree of severity) instead of 3 different words (*overweight*, *fat* and *obese*). Same idea has been implemented when the word *wasted*, *stunted* or *tall* is used. However, this model (Kamal *et al.* 2011*b*) is not applicable to parents, who are still growing — mother (father) below 19 (21) *years* of age. A number of cases fall in this category all over the world. This paper attempts to present a model covering such cases. Further, procedures for handling extreme cases reported by Kamal *et al.*, (2011*b*) have been extended and a comprehensive table is included in this paper. A new concept, *estimated-adult BMI* (body-mass index) for children, is introduced to, roughly, classify a child as *obese* or *wasted*. This work, also, looks in depth upon the sociological and the psychological implications of underage marriages.

THE NGDS PILOT PROJECT

The NGDS (National Growth and Developmental Standards for the Pakistani Children) Pilot Project was ini initiated after ‘Institutional Review Process’ taking into account of prevailing North American as well as European ethical and human-rights standards (Kamal *et al.*, 2002). ‘Opt-in policy’ has been adopted through *the* ‘Informed Consent Form’ (http://www.ngds-ku.org/ngds_folder/Protocols/NGDS_Form.pdf), signed by both parents. Heights, *h*, and masses were measured to accuracies of 0.1 *cm* and 0.1 *kg*, in the morning hours, according to protocols developed by the NGDS Team (Kamal, 2006), barefoot, with parents in minimal indoor-clothing and the children undressed to short underpants, everything else removed, including accessories (*cf.* Figure 1). Parents’ masses were ‘gross masses’ (masses in indoor clothing), which were converted to ‘net masses’ (masses with zero clothing) by subtracting a suit-able clothing correction. The children's recorded masses were very close to 'net masses' and used without any clothing correction (Tables 1 and 3 refer to these masses as 'net masses', μ).

MODELS OF GROWTH

ICP Model

ICP (**I**nfancy-**C**hildhood-**P**uberty) model presents an analysis of the longitudinal development of human body (Karlberg, 1987; 1996). It splits the growth curve into 3 separate and partly superimposed components (*cf.* Figure 2), which reflect different biologically interpretable periods (*i. e.*, **I**nfancy, **C**hildhood and **P**uberty). Infantile period starts, possibly, before birth with a greater 'height velocity', commonly known as 'growth velocity', accompanied with sharp deceleration, and continues up to 3 or 4 *years* of age. It may be a postnatal continuation of *fetal growth*, which Karlberg (1987) modeled using the following function**:**

$$Y = a_{\mathrm{I}} + b_{\mathrm{I}}(1 - e^{-c_{\mathrm{I}}t}) \tag{1}$$

Phase of childhood begins during first year of life and continues into maturity until the growth ceases. Growth process during this period is regulated by 'growth hormone'. It can be represented using the following function**:**

$$Y = a_{\mathrm{C}} + b_{\mathrm{C}}t + c_{\mathrm{C}}t^2 \tag{2}$$

Component of puberty represents the effect on linear growth induced by 'sex hormone'. It starts with an increased rate of growth and after attaining peak velocity, deceleration occurs till the end of the growth. This component can be described in terms of the following function**:**

$$Y = \frac{a_{\mathrm{P}}}{1 + e^{-b_{\mathrm{P}}(t - t_{\mathrm{V}})}} \tag{3}$$

In the above expressions, Y is the individual's height, a_{I}, a_{C}, a_{P}, b_{I}, b_{C}, b_{P}, c_{I} and c_{C} are constants, t is the age in *years*, t_{V} and t_{E} are the ages at peak velocity and at the end of growth (middle of the first one-year interval after age at peak velocity), respectively. According to this model, linear growth during the first three years of life is, mathematically, a combination of infancy and childhood components. From age 3 (*year*) to maturity, it is a combination of childhood component and sigmoid-shaped-pubertal component, the later acting only during adolescence. This model provides a longitudinal-growth standard, which is instrumental in detecting and understanding growth disturbances and related diseases. Estimated-adult height of an individual can, also, be predicted using this framework.

KFA Model

Kamal-Firdous-Alam model (Kamal *et al.*, 2004) assumed linearity for consecutive measurements. Adult-mid-parental (target) heights, were determined using (Tanner *et al.*, 1970; Chianese, 2005)**:**

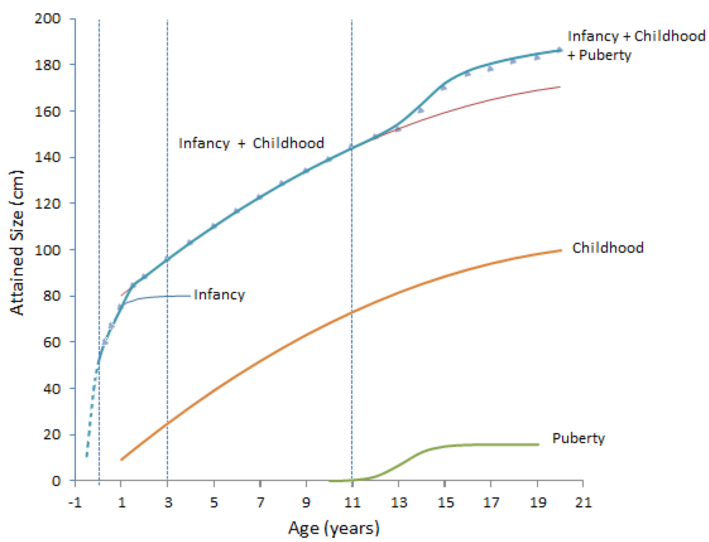

Fig. 2. ICP model

(4*a*) $$B = \frac{F + M + 13}{2}, \text{ for boys}$$

(4*b*) $$G = \frac{F + M - 13}{2}, \text{ for girls}$$

F (*M*) is biological father's (mother's) height. Heights and masses are measured in centimeters (*cm*) and kilograms (*kg*), respectively. Parents, sometimes, understand better, when the above relationships are explained in feet (*ft*) and inches (*in*). For a father measuring 5 *ft x in* and a mother measuring 5 *ft y in*, the target-height formulae, simply, reduce to:

(5*a*) $$B = 5\ ft\ (\frac{x + y}{2} + 2.56)\ in, \text{ for boys}$$

(5*b*) $$G = 5\ ft\ (\frac{x + y}{2} - 2.56)\ in, \text{ for girls}$$

Backward interpolation was used to compute desired height at reference-age grid and compared with interpolated-actual height. KFA model predicted height and weight during the next 6 months by estimating height velocities and rates of gain/loss of weight.

KJK Model

Kamal-Jamil-Khan model (Kamal *et al.*, 2011) provided growth-and-obesity profiles of a family (*cf.* Figure 3). For parent's calculations, linear interpolation was applied to gender-specific height and mass tables at the age of 20 *years* to get height and mass percentiles, $P(h)$ and $P(\mu)$, respectively. Mass or weight corresponding to height percentile, $P(h)$, was determined as 'optimal mass' (μ_{opt}) or 'optimal weight' (W_{opt})^b, which was compared with 'net mass' (μ) or 'net weight' (W). The concept of optimal mass was, formally, put forward by the first author and repor-

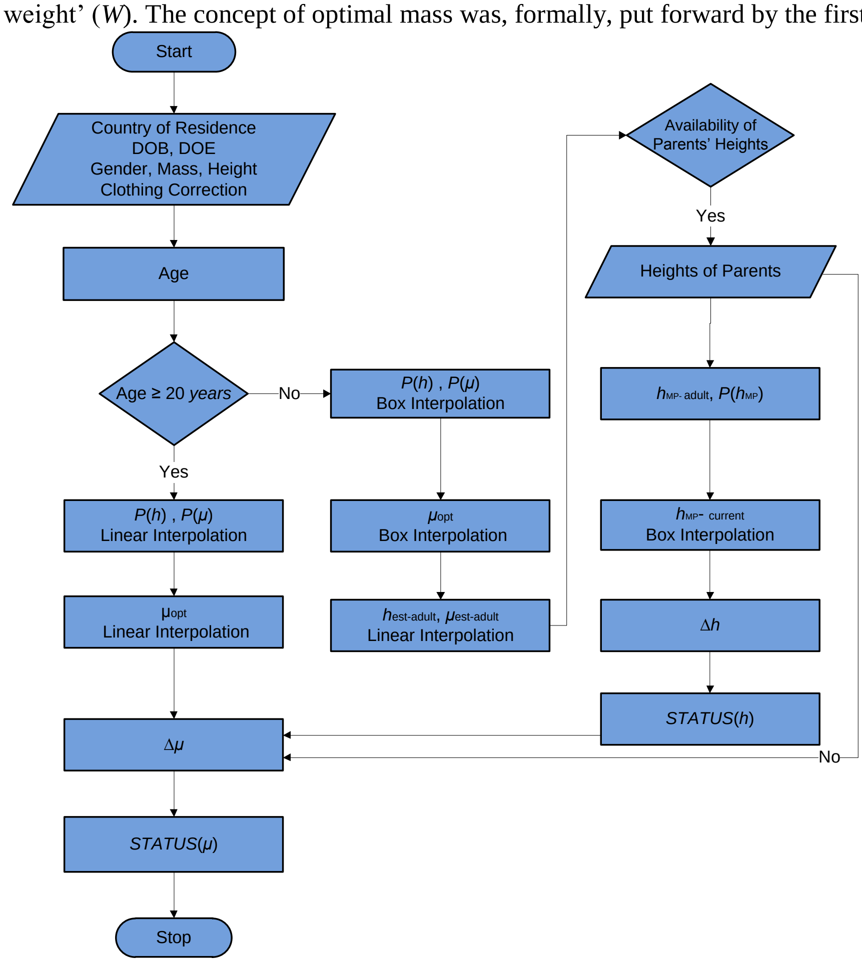

Fig. 3. Flowchart for KJK model

ted in the same journal (Kamal *et al.*, 2011). The parent was classified as 'obese' ($\mu > \mu_{\text{opt}}$) or 'wasted' ($\mu < \mu_{\text{opt}}$), a percentage indicating degree of severity — normal range consisting of 1% variation from optimal mass (end points included). Status (pertaining-to-mass) was expressed as a percentage

$$STATUS(\mu) = 100\frac{|W - W_{\text{opt}}|}{W_{\text{opt}}}\% = 100\frac{|\mu - \mu_{\text{opt}}|}{\mu_{\text{opt}}}\% \qquad (6)$$

Body-mass index, *BMI*, was computed by the formula — net mass, μ, in *kilograms* (*kg*) and height, *h*, in *meters* (*m*) and is reported in kg/m^2

$$BMI = \frac{\mu}{h^2} \qquad (7)$$

Target-height percentiles were obtained using procedures similar to those for obtaining parental-height percentiles. child's height (mass) percentile was calculated by first computing heights at the given age using 'box-interpolation technique' (constant-percentile and constant-age routes). Constant-age route was used to compute 'optimal mass' and, then, determine obesity profile using equation (6). Mid-parental height at current age was computed by a similar procedure. Comparing measured, h , and current-age-mid-parental, $h_{\text{CA-MP}}$, heights one was able to conclude if the child was 'tall' or 'stunted'. Status (pertaining-to-height) was written as a percentage

$$STATUS(h) = 100\frac{|h - h_{\text{CA-MP}}|}{h_{\text{CA-MP}}}\% \qquad (8)$$

Normal range was defined as 1% variation from current-age-mid-parental height (end points included).

MATURITY AND PUBERTY

According to Andrews *et al.* (1963), a person can claim to be an educated and a fully mature person, if (s)he conforms to four interrelated levels of maturity**:** physical, mental, social and spiritual, in the varied roles as an individual, a member of family as well as that of community (broadening associations). Physical maturity of an individual implies that (s)he knows what physical abilities (s)he has inherited and how to use them to the fullest and develop them; has knowledge and understanding of health and disease. As a member of family and community, (s)he should know own responsibilities towards prevention and cure of the illnesses for total health care of the family and, also, of the community. Mentally mature person recognizes the importance of positive outlook towards life situations, and importance of temperance. As a family member, (s)he should contribute to the betterment of emotional and physical health of the whole family and, also, to the community-health progress. One is socially mature, when one accepts factors, which one can't change, recognizes the importance of health in achieving life goals, and knows importance of getting well along with others. Spiritual maturity means to have faith in one's self, which keeps from getting easily discouraged by the setbacks and to respect other individual's beliefs.

The holy book of Muslims, 'Al-Quran', indicated 3 stages of puberty**:** *a)* 'Tameez'[c] (Al-Quran 24**:** 31[d] — *Suratun-Noor*), refers to male children, who do not know the delicacies of the covering of women; *b)* 'Balaghatul-hulm', synonymous to 'balaghatul-maheez' (Al-Quran 24**:** 58 — *Suratun-Noor*), the transition from childhood to puberty, the person is no longer called a 'child' but an 'adolescent', however, for legal or marital purposes, the incumbent is, still, considered a minor, requiring consent of custodial parent for elective medical procedures or entering a legal contract — P section of ICP curve corresponds to this key stage; *c)* 'Balaghatun-nikah' (Al-Quran 4**:** 6 — *Suratun-Nisaā*), the marriageable age — the last one is, sometimes, confused with the transition from childhood to puberty, mentioned in *b)*. In the opinion of authors, 'balaghatun-nikah' (the marriageable age) is the age when the mind and the body of a boy as well as a girl regains steady state after the perturbation ('balaghatul-hulm', hitting puberty) is applied ('perturbation' is a term, commonly, used, in quantum mechanics, a branch of mathematical physics, and could be, roughly, considered equivalent to 'impulse', which acts on a system, previously, in steady state) — vehemently opposing the notion of marrying a person, immediately, upon attaining puberty. Kamal (2011*c*) elaborates difference between equilibrium and steady state by giving definitions both in terms of energy transfer as well as probabilities of occupation. Next paragraph elaborates this point further.

ICP MODEL: PERSPECTIVES FROM PHYSICS, MATHEMATICS AND CONTROL THEORY

Child growth is a 'quasi-static', though 'irreversible' process, in the language of thermodynamics. An abrupt change in height during phase transition from 'infancy-to-childhood' (*cf.* section on Models of Growth for hormonal secretion causing this transition as well as the one mentioned near the end of this paragraph) renders the height curve 'continuous', but 'non-smooth'. Continuity ensures that 'height function' is single-valued and bounded, suggesting height of a child to be a 'well-behaved function'. Non-smoothness, on the other hand, suggests that 'height function' may not be differentiable — height velocity may not be defined in the neighborhood of the transition region. Phase transition from 'childhood-to-puberty' would have the same mathematical implications (Kamal *et al.*, 2004).

The process of gaining height by a child may be visualized in the context of control theory. The 'impulse' (hormonal secretion) results in 'response' (height gain), whose effectiveness is determined by 'transfer function' — a function describing how effectively the impulse is translated into response. A transfer function close-to-100% would imply that impulse is, almost, totally transmitted, *e. g.*, a rigid bodies, belts, shafts or other such devices in mechanical engineering, which are used to transfer applied force to various parts of a machine. On the other hand, a transfer function close-to-zero means that impulse is, almost, totally absorbed, *e. g.*, cotton, foam and shock absorbers of luxury cars (*cf.* sections on 'Underage and Forced Marriages**:** Implications', for application of transfer-function approach to child upbringing, and 'Discussion', for application to organizational structure). The 'impulse' (release of sex hormone) results in 'response', which sends a person's physiological and psychological state into 'puberty-induced transient' (transfer function depends on state variables). The time to get back to 'steady state' (transfer function becoming constant), called 'relaxation time', is different for different persons. Tying two persons into wedlock has its, own pressures, and often takes the couple's physical and emotional states into 'marriage-induced induced transient'. Combining the two transients may produce 'resonance' ('avalanche', in terms of emotions and reactions — neuro-transmitters working at more than the desired rate, possibly, sending the female adolescent into a state of depression). Resonance is a phenomenon of physical systems (driven oscillators), where frequency of the driving force matches with the natural frequency of system, resulting in a sharp increase in amplitude (Marion, 1970).

Bhutta (2002) mentioned that children suffering from severe disease (*e. g.*, diarrhea) during the weaning period may continue on the infantile curve a little longer, before picking up the childhood curve and, hence, end up shorter. The authors would like to add that a similar situation occurring near the end of childhood period — delayed puberty (due to natural or artificial causes — sometimes encouraged by coaches of international gymnastics) may induce the same effect — stunting in adolescents.

There was a suggestion[e] that ICP model should, actually, be called FICP (**F**etal-**I**nfancy-**C**hildhood-**P**uberty) model as it, also, includes period of life before birth. However, the fetal and the infantile curves are, actually, not different components of growth curve. Single function is well fitted to fetal-infantile portion (throughout this period, the curve is, not only, 'continuous', but also, 'smooth' — differentiable in the mathematical language, which means that 'height velocity' is defined everywhere in the region), which has, already, been mentioned in Al-Quran (46**:** 15 — *Suratul-Ahqaāf*). It states that period of 'gestation', synonymous to pregnancy (fetal growth), and 'lactation' synonymous to weaning (infancy), is a period of 30 months (a minimum of 6 months for gestation and a minimum of 24 months for lactation), suggesting that F and I should not be separate regions. There is, also, a linguistic problem in this suggested nomenclature — lining up one adjective (fetal) with 3 nouns (infancy, childhood, puberty). Therefore, the authors would stick to the established terminology — ICP model. With this observation of same expression (of function) describing fetal and infantile periods, there could be question why age of the child is, universally, recorded from the time of birth, not the time of conception. The later practice could have the added advantage of making interpretation of graph simpler by avoiding negative time (period before birth). However, it is not practical as date and time of conception are not 'well-defined', (prospective mothers, even, do not know that they have conceived, till some time has elapsed — tests are needed to confirm pregnancy), whereas date and time of birth can be 'clearly documented'.

GROWTH-AND-OBESITY PROFILES OF STILL-GROWING PARENTS

Mathematical Model

The first step is computation of fractional ages (*years*) of parents, according to procedures reported by Kamal *et al.* (2011*b*). Percentiles corresponding to father's and mother's heights are calculated through 'box interpolation' using Tables B1 and B2 (*cf.* Appendix B), respectively. These percentiles are used to determine estimated-adult height of each parent through linear interpolation from heights at age 20 read from respective gender-specific table. These are used in place of measured heights of parents in equation (4*a*) or (4*b*) depending on whether one wants to compute target height of boy or girl. Rest of the procedure is same as described for KJK model (*cf.* Figure 3) — step-by-step method is reported in Kamal *et al.* (2011*b*). A new parameter, estimated-adult *BMI*, is included in the growth-and-obesity profiles — *cf.* equation (7) for units of estimated-adult mass, $\mu_{\text{est-adult}}$, estimated-adult height, $h_{\text{est-adult}}$, and estimated-adult *BMI*, $BMI_{\text{est-adult}}$.

Table 1. Parents' Growth-and-Obesity Profiles§

	Father	*Mother*
Case Number	**SGPP-KHI-20080104-01 (simulated)**	
Date of Birth	1990-07-04	1992-12-30
Date of Checkup	2009-02-05	2009-02-05
Age (*years*)	18.59	16.10
Height, h (*cm*)	170.1	157.0
Height (*ft-in*)£	5 *ft* 6.97 *in*	5 *ft* 1.81 *in*
Percentile-of-Height, $P(h)$	19.53	20.35
Estimated-Adult Height (*cm*)	170.4	157.7
Estimated-Adult Height (*ft–in*)	5 *ft* 7.07 *in*	5 *ft* 2.08 *in*
Gross Mass (*kg*)	59.9	54.1
Clothing Correction (*kg*)	0.5	1.0
Net Mass, μ (*kg*)	59.4	53.1
Net Weight, W (*lb-oz*)	130 *lb* 15.63 *oz*	117 *lb* 1.37 *oz*
Percentile-of-Mass, $P(\mu)$	18.39	45.28
Estimated-Adult Mass (*kg*)	61.0	57.1
Estimated-Adult Weight (*lb-oz*)	134 *lb* 9.75 *oz*	125 *lb* 15.07 *oz*
BMI ¥, $10^4\mu/h^2$ (kg/m^2)	20.5	21.9
$BMI_{\text{est-adult}}$ ¥ (kg/m^2)	21.0	23.0
Optimal Mass, μ_{opt} (*kg*)	59.8	47.7₣
Optimal Weight, W_{opt} (*lb-oz*)	131 *lb* 13.52	105 *lb* 1.76 *oz*₣
Δ Mass-for-Height, $\Delta\mu$ (*kg*)	–0.4	+5.4₣
Δ Weight-for-Height, ΔW (*lb-oz*)	–13.89 *oz*	+11 *lb* 15.61 *oz*₣
STATUS(μ)∃	**0.66 % (–)**Σ	**11.39% OBESE**₣

§ Detailed Growth-and-Obesity Profiles given above and in Tables 2 & 3 are based on mathematical calculations uploaded as **Additional File 1 — Calculations of H. Family:**
http://www.ngds-ku.org/Papers/J30/Additional_File_1.pdf

£ *ft* stands for *feet* and *in* for *inch(es)*

¥ *BMI* stands for *Body-Mass Index*, whereas $BMI_{\text{est-adult}}$ refers to estimated-adult *BMI*, *cf*. equation (9)

₣ For pregnant woman, estimated mass of the fetus should be added to optimal mass. This result is, then, used in place of optimal mass to determine the Status (pertaining-to-mass). Since the status of pregnancy is not, always, certain, the recommendations for married or recently-divorced females are structured as follows**:** $\mu < \mu_{\text{opt}}$ gain $\Delta\mu = \left|\mu - \mu_{\text{opt}}\right|$, if $\mu > \mu_{\text{opt}}$, lose $\Delta\mu - 5\ kg$

∃ Status, pertaining-to-mass

Σ (–) means the person has lesser weight-for-height, but is not considered wasted.

$$BMI_{\text{est-adult}} = \frac{\mu_{\text{est-adult}}}{(h_{\text{est-adult}})^2} \tag{9}$$

Sample Profiles

Sample profiles are worked out for simulated data. They are given the name, H. Family, for the purpose of reporting profiles. Table 1 lists parents' growth-and-obesity profiles and adult-mid-parental (target) heights, whereas Table 2 gives the values of adult-mid-parental height for both genders.

Table 2. Adult-mid-parental (Target) heights

BOY/GIRL = (*FATHER* + *MOTHER* ± 13)/2	*BOY*	*GIRL*
Case Number	**SGPP-KHI-20080104-01 (simulated)**	
Adult-Mid-Parental (Target) Height (*cm*)	170.5	157.5
Adult-Mid-Parental (Target) Height (*ft-in*)	5 *ft* 7.13 *in*	5 *ft* 2.02 *in*
Percentile-of-Mid-Parental Height	20.07	19.78

*Father's Height Profile***:** At the age of 18.59 *years*, height of father is 170.1 *cm* (5 *ft* 6.97 *in*), which lies at 16th (16.00 to be exact) percentile. Based on height percentile, his estimated-adult height comes out to be 170.4 *cm* (5 *ft* 7.07 *in*).

*Father's Mass Profile***:** At the age of 18.59 *years*, net mass (weight) of father is 59.4 *kg* (130 *lb* 15.63 *oz*), which lies at 18th (18.39 to be exact) percentile [0.66% LESSER mass-for-height, not considered wasted], corresponding to *BMI* of 20.5 *kg*/*m*^{2}. Father has 0.4 *kg* LESSER mass (UNDERWEIGHT by 13.89 *oz*) for his height. Based on mass (weight) percentile, his estimated-adult mass (weight) comes out to be 61.0 *kg* (134 *lb* 9.75 *oz*), corresponding to an *estimated-adult BMI* of 21.0 *kg*/*m*^{2}.

*Mother's Height Profile***:** At the age of 16.10 *years*, height of mother is 157.0 *cm* (5 *ft* 1.81 *in*), which lies at 20th (20.35 to be exact) percentile. Based on height percentile, her estimated-adult height comes out to be 157.7 *cm* (5 *ft* 2.08 *in*).

*Mother's Mass Profile***:** At the age of 16.10 *years*, net mass (weight) of mother is 53.1 *kg* (117 *lb* 1.37 *oz*), which lies at 45th (45.28 to be exact) percentile [11.39% OBESE], corresponding to *BMI* of 21.9 *kg*/*m*^{2}. Mother has 5.4 *kg* EXCESS mass (OVERWEIGHT by 11 *lb* 15.61 *oz*) for her height. Based on mass (weight) percentile, her estimated-adult mass (weight) comes out to be 57.1 *kg* (125 *lb* 15.07 *oz*), corresponding to an estimated-adult BMI of 23.0 *kg*/*m*^{2}.

*Height Profile of Z. H.***:** At the age 3.22 *years*, height of Z. H. is 98.1 *cm* (3 *ft* 2.62 *in*), which lies at 64th (64.01 to be exact) percentile [5.37% TALL]. Z. H. is 5.0 *cm* (1.97 *in*) TALLER, with respect to the current-age-mid-parental height. Based on height percentile, his estimated-adult height comes out to be 179.6 *cm* (5 *ft* 10.70 *in*).

*Mass Profile of Z. H.***:** At the age 3.22 *years*, net mass (weight) of Z. H. is 12.7 *kg* (28 *lb* 0.06 *oz*), which lies at 10th (9.75 to be exact) percentile [18.12% WASTED], corresponding to *BMI* of 13.2 *kg*/*m*^{2}. Z. H. has 2.8 *kg* LESSER mass (UNDERWEIGHT by 6 *lb* 3.13 *oz*) for his height. Based on mass (weight) percentile, his estimated-adult mass (weight) comes out to be 58.1 *kg* (128 *lb* 3.15 *oz*), corresponding to an *estimated-adult BMI* of 18.03 *kg*/*m*^{2}.

*Height Profile of T. H.***:** At the age 3.22 *years*, height of T. H. is 95.2 *cm* (3 *ft* 1.48 *in*), which lies at 49th (49.01 to be exact) percentile [3.74% TALL]. T. H. is 3.4 *cm* (1.35 *in*) TALLER, with respect to the current-age-mid-parental height. Based on height percentile, her estimated-adult height comes out to be 163.3 *cm* (5 *ft* 4.30 *in*).

*Mass Profile of T. H.***:** At the age 3.22 *years*, net mass (weight) of T. H. is 15.8 *kg* (34 *lb* 13.42 *oz*), which lies at 79th (79.12 to be exact) percentile [11.39% OBESE], corresponding to *BMI* of 17.4 *kg*/*m*^{2}. T. H. has 1.62 *kg* EXCESS mass (OVERWEIGHT by 3 *lb* 8.98 *oz*) for his height. Based on mass (weight) percentile, her estimated-adult mass (weight) comes out to be 68.5 *kg* (151 *lb* 2.21 *oz*), corresponding to an *estimated-adult BMI* of 25.7 *kg*/*m*^{2}.

Figure 4 shows bar chart displaying children's heights, estimated-adult heights, current-age-mid-parental heights and target (adult-mid-parental) heights. Figure 5 illustrates masses, optimal masses and their difference, whereas

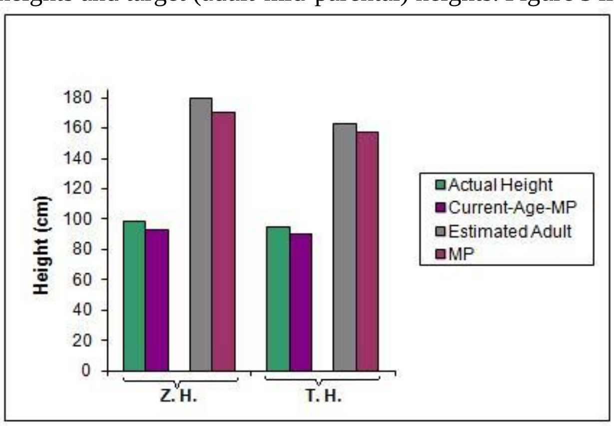

Fig. 4. Bar chart showing children's heights, estimated-adult heights, current-age-mid-parental heights and target (adult-mid-parental) heights[ɜ]

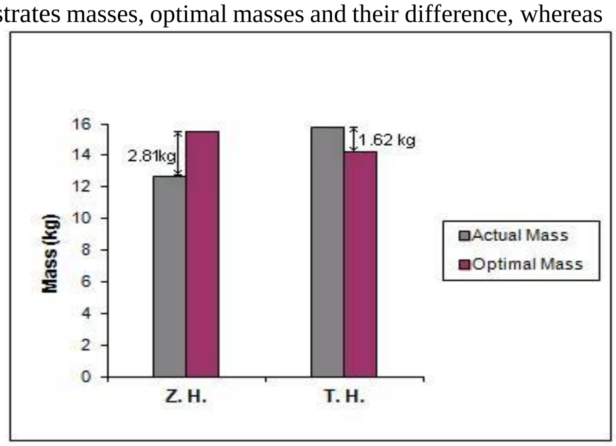

Fig. 5. Bar chart showing children's masses, optimal masses (optimal mass is the mass corresponding to height percentile) and their difference[∀]

ɜ Both children are tall as their actual heights are more than their respective current-age-mid-parental heights

∀ Both children are obese as their actual masses are more than their respective optimal masses

Table 3. Growth-and-Obesity Profiles of children of H. Family

Child's Initials	*Z. H.*	*T. H.*
Case Number	**SGPP-KHI-20080104-01 (simulated)**	
Photograph©		
Scanned Signatures©	*ZH*	*TH*
Gender	Male	Female
Date of Birth	2005-11-15	2005-11-15
Date of Checkup	2009-02-05	2009-02-05
Age (*years*)	3.22	3.22
Height, h (*cm*)	98.1	95.2
Height (*ft-in*)	3 *ft* 2.62 *in*	3 *ft* 1.48 *in*
Percentile-of-Height, $P(h)$	64.01	49.01
Estimated-Adult Height (*cm*)⊃	179.6	163.3
Estimated-Adult Height (*ft-in*)⊃	5 *ft* 10.70 *in*	5 *ft* 4.30 *in*
Mid-Parental-Height Percentile	20.07	19.78
Current-Age-Mid-Parental Height (*cm*)	93.1	90.1
Δ Height-for-Age, Δh (*cm*)	+5.0	+3.4
Δ Height-for-Age (*in*)	+1.97	+1.35
STATUS(h)⊂	**5.37 % TALL**	**3.74 % TALL**
Gross Mass (*kg*)	12.7	15.8
Clothing Correction (*kg*)€	0	0
Net Mass, μ (*kg*)	12.7	15.8
Net Weight, W (*lb-oz*)	28 *lb* 0.06 *oz*	34 *lb* 13.42 *oz*
Percentile-of-Mass, $P(\mu)$	9.75	79.12
Estimated-Adult Mass (*kg*)	58.1	68.5
Estimated-Adult Weight (*lb-oz*)	128 *lb* 3.15 *oz*	151 *lb* 2.21 *oz*
BMI, $10^4\mu/h^2$ (kg/m^2)	13.2	17.4
$BMI_{\text{est-adult}}$¥ (kg/m^2)	18.0	25.7
Optimal Mass, μ_{opt} (*kg*)	15.5	14.2
Optimal Weight, W_{opt} (*lb-oz*)	34 *lb* 3.19 *oz*	31 *lb* 4.44 *oz*
Δ Mass-for-Height, $\Delta\mu$ (*kg*)	–2.8	+1.6
Δ Weight-for-Height, ΔW (*lb-oz*)	–6 *lb* 3.13 *oz*	+3 *lb* 8.98 *oz*
STATUS(μ)	**18.12% WASTED**	**11.39% OBESE**

© Photographs and scanned signatures (not real, as we presented simulated data) on the day, check up was conducted.
⊃ Cutoff heights for induction in the Armed Forces of Pakistan**:**
Males 5 *feet* 4 *inches* (162.56 *cm*)
Females 5 *feet* 2 *inches* (157.48 *cm*)
⊂ Status, pertaining-to-height, determined by taking current-age-mid-parental height as reference
€ Clothing correction for children was taken as zero, as ideal weighing and measuring required complete undressing except briefs or panties — *cf.* Kamal (2006) for recommended clothing corrections

Table 3 contains children's profiles, showing optimal mass as well as statuses, pertaining-to-height and -mass.

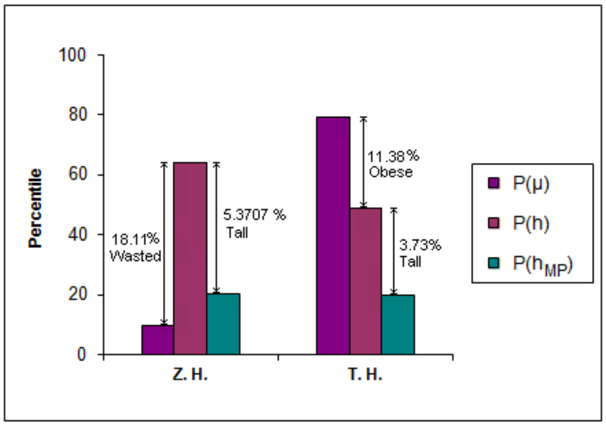

Fig. 6. Bar chart showing percentiles of children's net masses, heights and mid-parental heights

Figure 6 displays percentiles of children's net masses, heights and mid-parental heights.

UNDERAGE AND FORCED MARRIAGES: IMPLICATIONS

Underage marriage — 'very-young marriage', when the boy or the girl has not, even, entered secondary school or 'late marriage', when all education is finished and the couple is in the middle of professional career. According to International Center for Research on Women (2010), 45 per cent of Indian females get married before the age of 18 *years* (Pidd, 2012). In many areas of the world, such marriages are quite frequent, which disconcert the young females, badly (Ali and Minoui, 2012). This discomfiture makes the females incapable of fulfilling their responsi-bilities as managers of their household. Apart from emotional imbalance and, possible, retardation of mental capabilities, such marriages could, also, effect physical growth and both married boy and married girl might not be able to attain estimated-adult height. Underage mothers run a very high risk of mortality during labor. Tanushree Soni, Plan International's regional-gender-program specialist for the Asia region observes, "Girls under the age of 20 are two to five times more likely to die in childbirth or pregnancy." They are not, even, able to take up their prime duties, to parent and to nurture their children, successfully, which need considerable and constant attention, making them emotionally stable. A close-to-zero transfer function, when it comes to personal provocation, and a close-to-hundred transfer function, when it comes to standing against deception, hate, injustice, oppression and, above all, myopic interpretation of religion or customs, are the desired transfer-function values, in order to make the future generation 'visionaries' instead of 'rebels'[f] (*cf.* sections on 'ICP Model: Perspectives from Physics, Mathematics and Control Theory', for explanation of transfer-function approach, and 'Discussion', for application to organizational structure). In this context, the remark made by the first author (SAK),"A teacher has the power to make a student 'tolerant' in one minute and 'terrorist' in another minute, not only, in the religious schools, but also, in the secular schools" (Kamal, 2011*e*), may be restated as, "A mother has the power to make her child *leader-integrator* (Ghani, 2012) in one instant and *radical* in another instant, in the very first school of a child — her mother's lap"[g]. When one or both life-partners are underage, they are neither physically nor emotionally prepared to cope with pressures of marriage and starting a new life — legal intricacies of such marriages arise from fact that life-partners are not, officially, in a position to give consent for the marriage contract. Although, 'late marriage' comes with maturity and responsibility, there are problems associated with this set up. For example, subsiding of vitalities necessary to enjoy the beautiful marital relationship. The couple may, instead, view the relationship as a liability. This is, further, corro-borated by the saying of Imam-ul-Ambeeya (spiritual leader of all prophets), Muhammed (peace and blessings be upon him) that parents should not delay the marriage of their sons or daughters, 'once they reach the marriageable age' — an undue delay in marriage would distract the minds of youngsters and many encourage out-of-wedlock relationships, which have their own complications. This, also, rules out very-young marriages — a deviated thinking propagated by some scholars. Additionally, 'late marriages' increase chances of abnormalities in the offspring because of older age of mother. It is said that the 'middle path' is the best one[b], 'balaghatun-nikah' is the marriageable age, when the young minds and the young bodies of female as well as male adolescents come to stability after transition from childhood to puberty. 'Balaghatun-nikah', therefore, does not coincide with 'balaghatul-hulm', the age of entering puberty, deciding clearly against child marriages. Usmani (1981) has mentioned (page number 70) that Kazi Ibn-é-Shabarma, who was a contemporary of Imam Abu Hanifa (Allah may have His Mercy on Abu Hanifa), has fixed marriageable age as 16 *years* for females and 18 *years* for males. Islamic Republic of Pakistan has, also, set the lowest marriageable age as stated above. Usmani (1981) has given many arguments in the first 92 pages of his book against the marriage of Ummul Mu'meneen Aisha (Allah be pleased with her) at the tender age of just 9 *years*. Ahmed (2012) states that there is a consensus of Islamic scholars that Bibi Aisha (Allah be delighted with her) was 10-*year* younger than her sister, Asma (Allah be contented with her), who was 28-*year* old, at the time of 'Hijrah' (religious migration from Makkah Mukarramah to Madina Munarrarah, the holy cities located in the Kingdom of Saudi Arabia). Mae Aisha (Allah be happy with her) was married after 'Hijrah'. Therefore, her age at marriage was about 18 *years*, not 9 *years* as believed, commonly.

Love marriage, *arranged marriage* or *forced marriage* — the best one for the potential family and the society**:** 'Forced marriage'[h], where a person is pushed into a relationship without consent, has similar consequences as 'under-age marriage'. The situation, when the victims are compelled to start a new life, leaving behind their families, friends, schools and jobs (Bouquet, 2012), results in such an overburdened state of mind, which makes it, almost, impossible to accomplish their duties as guardians and caretakers of their family. In contrast to 'forced marriage', 'love marriage' may appear to be an admirable decision. However, it has its own complications, as could be visualized by the alarming number of broken marriages or life-partner abuse/murder in this category. Referring to the 'middle path', mentioned above; 'arranged marriage' looks like to be the optimal solution[b], avoiding both extremes, as long as the main stakeholders (both male and female) are taken into confidence.

DISCUSSION

Insights from physics, mathematics and control theory suggest new lines of research for other workers, based on ideas presented in this work. For a physicist, identification of child growth as an irreversible, quasi-static process opens up new directions of research, *e. g.*, determination of entropy of child-growth process, looking into the thermodynamical basis of this phenomenon. This may lead to a better understanding of physiological basis of optimal weight-for-height, paving the way for more efficient and highly effective diet-cum-exercise plans in primary-school children. For a mathematician, an in-depth study of height function is needed to validate the suggestion that it behaves as a well-behaved function, in particular, an analytical check whether this function is not differentiable in the transition regions (infancy-to-childhood, childhood-to-puberty). Discrete mathematicians, in collaboration with educational psychologists, have the challenge to establish validated developmental-milestones for the Pakistani children (Kamal, 1998*b*; 2002) based on 'precedence graphs' (educational background of elders, family genes, value-system established by ancestors) and 'influence graphs' (clergy, society/media, teachers). For a control scientist, quantita-tive determination of 'relaxation time', during phase transition from 'childhood-to-puberty', becomes very important to minimize the physiological, the psychological and the sociological pressures associated with very-young marriages. Determination of such relaxation times might require molecular, atomic or even sub-atomic, approaches to signal-generation and -transmission mechanisms in the human brain. Covariant (Kamal *et al.*, 1989), generalized-coupling (Kamal *et al.*, 1992) and covariant-generalized-coupling (Kamal and Siddiqui, 1997) models of global electro-cortical activity and associated group structures (Siddiqui *et al.*, 1993)[i], should be set up using quantum-field theory, employing techniques of second quantization. It is the perception of the first author (SAK) that a 'third-quantization approach' is needed, linearizing general theory of relativity (Kamal, 2010*a*) to effectively handle relaxation-time-computation problem. Once determined, this should become the minimum required time-lapse following puberty, after which the adolescents are allowed to be married. This might become the biological basis of setting the lowest marriageable age (balaghatun-nikah).

The social innovation going on in today's organizations revolves around behavioral science, personality and philosophy (Ghani, 2012). The 'organizational inertia' (Kelly and Amburgey, 1991) may be considered as a prime factor in resisting change-for-better. There is a need to find out 'transfer function' of the organization (effectiveness in transmitting 'ripples-of-change' through various managerial layers) to be able to manage better the strategy of bringing about change-for-better. The integrated household (underage couple and children) could be considered as a small organization, battling for its survival.

Some of the problems arising right after the conclusion of a marriage ceremony, are discoveries of the different natures and the temperaments as well as the universes of discourse (if that is the case) of life partners, making emotional matching difficult. Opportunities of possible understanding are undermined by a regimental post-marriage routine instead of a relaxed one, visitors and too-many social functions, turning the private life of a couple into a social obligation. Remedy is a cool-off period, with possible vacation to a secluded place, away from close relatives and friends, before indulging in fresh and demanding responsibilities, thus allowing the 'marriage-induced transient' to come to the steady state.

'Underage marriage' is a global problem, not confined to a particular region or society. Its adverse effects may be minimized, if physical examination of couples is mandated by state, to maintain proper weight-for-height [d], with specific quantitative recommendations to gain/lose 1 *lb* per week for so many weeks using software developed on the basis of anothomathematical tools (Kamal, 2011*b*). Marital counseling should be conducted by same-gender counselor, one before marriage (pre-marital), and another after marriage (post-marital). The former, for the purpose of orienting one life-partner towards another, and later, to establish rapport so that each partner starts understanding feelings of the other[j]. Moreover, childrearing counseling to be conducted upon conceiving a child, which should include parental recognition of signs and symptoms of depression as well as all forms of abuse in their offspring (Kamal, 2011*e*). Smoking, drinking or use of controlled substances should be, strictly, avoided during pregnancy. Soon-to-be mother should not read literature or watch videos dealing with extreme violence, abuse or other inappropriate material. Family disputes, which may lead to depression, should be avoided at all costs during this period, as these may contribute to IUGR (Intra-Uterine-Growth-Retardation), which may become a leading factor in inducing stunting and reduced mental capability in children. Depression during this period may lead to dislocation of fetus during pregnancy and obstructed labor as well as other complications during delivery. Hence, the gynecologists should be mandated to do (complete) head-to-toe examination during pregnancy (to be protected by tetanus booster), which must include recognizing any form of abuse (Kamal, 2011*e*), ruling out trunk deformities, in particular, scoliosis[k], looking for depression and associated psychiatric disorders. Last 2 conditions mentioned could make 'active participation' (work done *by* the system in the context of thermodynamics) in the delivery process (normal birth) extremely difficult, hence leaving the choice only for 'passive participation', *i. e.*, cesarean section (work done *on* the system in the context of thermodynamics). A hybrid (active and passive) participation (forceps delivery) should be avoided, whenever possible, as this may inflict damage to head of fetus. Hence, it becomes evident that the decision for mode of delivery should be based, not only, on considerations of the body structure and the body mass, but also, on the mental state of female ('physiology' influenced by 'anatomy' and 'psychology').

Scoliosis screening of married females as well as study of structure of bones and muscles, playing a leading role in active participation, may form the basis of 'gynecological orthopedics (GO)'[l] — anatomy, study of body structures (algebra, a branch of mathematics, deals with the study of structures, whereas ideas from geometry could lead to metric of woman — a challenge for anthromathematicians (Kamal, 2010*b*; 2011*b*; *d*; *f*; 2012*a*) of the next generation), may find its roots in 'orthopedics' (study of bones, joints and skeletal deformations — topology, another branch of mathematics, deals with invariance under deformations).

Future mothers should maintain proper weight-for-height[d] (as per recommendations given in Table 1), not to have over(under)fat conditions and have a peaceful and a relaxed lifestyle, so that they may go through, easily, with pressures of labor, preferably through active participation. Baby should be delivered in a well-equipped facility (certified by JCI[m] in infection-control protocols), having qualified obstetricians and gynecologists, followed by a complete examination by a neonatologist and a head-to-toe (stripped) examination every six months. The rapport established between life-partners, during post-marital counseling, should help them create conditions to ensure a balanced, a healthy and a fruitful childhood.

Detection and treatment of growth disorders and pediatric obesity, is especially crucial in case of a family, in which one or both parents are, still, growing. The procedures, presented in this document, for generating growth-and-obesity profiles for such special cases, are very instrumental for pediatricians, nutritionists (Kamal, 2012*a*) and physical-education teachers (Kamal *et al.*, 2012), in spotting disorders in physical growth. The profiles are presented through tables, accompanied with bar graphs, avoiding technical terminologies, which make them easy-to-understand and parent-friendly. A number of adverse consequences are linked to childhood obesity (Ludwig, 2007). Slight weight increase is responsible for elevating risk factor of coronary heart disease in adulthood (Baker *et al.*, 2007; Bibbins-Domingo *et al.*, 2007). Degree of obesity, in percentage form (Kamal *et al.*, 2011*b*), is associated with clinical implications in children and adolescents (Kamal, 2011*f*). Significant morbidity is faced by obese children with Blount's disease (Campbell *et al.*, 2006). Children with myelomeningocele, also, experience obesity as a common problem, affecting independence and proficiency with transfers, mobility and self-care activities (Campbell *et al.*, 2006). For these reasons, there is a pressing need to have countrywide programs for monitoring growth and development of children, as well as for developing national growth[n] cum developmental standards (Kamal, 1998; 2002) and references for the children of our nation (a humble effort has, already, been initiated by our group in the form of 'the NGDS Pilot Project' (http://ngds.uok.edu.pk), to ensure better monitoring of growth, and thus, effectively, intervening the problems encountered. Bringing in the power of mathematics to model human body (Kamal, 2011*d*), our group has improved height- and mass-measurement techniques. Heights can, now, be measured to accuracies of 0.01 *cm* and masses to 0.01 *kg* (Kamal, 2010*b*). Currently, we are in the process of analyzing accuracy, precision and reproducibility (Kamal, 2009*b*) of these techniques. These efforts should ascertain the welfare and the health care of torchbearers of future as national assets.

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APPENDIX A: EXTREME CASES

We list below the extreme cases, which are updated and expanded from the list given previously (Kamal *et al.*, 2011*b*). If any one, two or all of percentiles of height, mass and mid-parental height, $P(h)$, $P(\mu)$ and $P(h_{MP})$, lie outside the range [3, 97], the procedure for status computation is different from the one reported (*cf.* Table A1).

Table A1. Extreme cases ($^{\not\subset}$status non-determinable; $^{\forall}$regular calculations)

$P(\mu)$	$P(h)$	$P(h_{MP})$	$STATUS(\mu)$	$BMI_{est\text{-}adult}$	$STATUS(h)$
< 3	< 3	< 3	ND $^{\not\subset}$	ND	ND
< 3	< 3	$3 \le P(h_{MP}) \le 97$	ND	ND	(*b*)
< 3	< 3	> 97	ND	ND	(*d*)
< 3	$3 \le P(h) \le 97$	< 3	(*f*)	(*d*)	(*g*)
< 3	$3 \le P(h) \le 97$	$3 \le P(h_{MP}) \le 97$	(*f*)	(*d*)	RC
< 3	$3 \le P(h) \le 97$	> 97	(*f*)	(*d*)	(*d*)
< 3	>97	< 3	(*h*)	(*h*)	(*g*)
< 3	>97	$3 \le P(h_{MP}) \le 97$	(*h*)	(*h*)	(*f*)
< 3	>97	> 97	(*h*)	(*h*)	ND
$3 \le P(\mu) \le 97$	< 3	< 3	(*i*)	(*i*)	ND
$3 \le P(\mu) \le 97$	< 3	$3 \le P(h_{MP}) \le 97$	(*i*)	(*i*)	(*b*)
$3 \le P(\mu) \le 97$	< 3	> 97	(*i*)	(*i*)	(*d*)
$3 \le P(\mu) \le 97$	$3 \le P(h) \le 97$	< 3	RC $^{\forall}$	RC	(*g*)
$3 \le P(\mu) \le 97$	$3 \le P(h) \le 97$	$3 \le P(h_{MP}) \le 97$	RC	RC	RC
$3 \le P(\mu) \le 97$	$3 \le P(h) \le 97$	> 97	RC	RC	(*d*)
$3 \le P(\mu) \le 97$	>97	< 3	(*f*)	(*f*)	(*g*)
$3 \le P(\mu) \le 97$	>97	$3 \le P(h_{MP}) \le 97$	(*f*)	(*f*)	(*f*)
$3 \le P(\mu) \le 97$	>97	> 97	(*f*)	(*f*)	ND
> 97	< 3	< 3	(*b*)	(*b*)	ND
> 97	< 3	$3 \le P(h_{MP}) \le 97$	(*b*)	(*b*)	(*a*)
> 97	< 3	> 97	(*b*)	(*b*)	(*d*)
> 97	$3 \le P(h) \le 97$	< 3	(*e*)	(*c*)	(*g*)
> 97	$3 \le P(h) \le 97$	$3 \le P(h_{MP}) \le 97$	(*e*)	(*c*)	RC
> 97	$3 \le P(h) \le 97$	> 97	(*e*)	(*c*)	(*d*)
> 97	>97	< 3	ND	ND	(*g*)
> 97	>97	$3 \le P(h_{MP}) \le 97$	ND	ND	(*f*)
> 97	>97	> 97	ND	ND	ND

Table B1. Height-for-age percentiles of boys (2 to 20 years)

Percentiles → **Ages↓**	**3**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**97**
2.0	80.00	81.00	82.50	84.00	86.00	88.25	91.00	92.50	93.00
2.5	83.50	84.50	86.00	88.50	90.50	93.50	95.00	96.50	97.50
3.0	88.00	88.75	90.00	92.50	95.00	97.50	100.00	102.00	102.50
3.5	91.00	92.00	93.50	95.50	98.50	101.50	104.00	105.00	106.25
4.0	93.50	95.00	97.00	99.00	102.00	105.50	107.50	109.00	110.50
4.5	96.50	98.00	100.00	103.00	106.00	109.00	111.00	113.00	114.00
5.0	100.00	101.50	103.00	106.00	109.00	112.00	115.00	116.75	118.00
5.5	103.00	104.00	106.00	109.00	112.50	115.00	118.00	120.00	121.75
6.0	106.00	107.50	109.00	112.00	116.00	119.00	121.50	121.00	125.00
6.5	109.00	110.00	111.50	115.00	119.00	121.75	125.00	127.00	128.50
7.0	111.00	113.00	115.00	118.25	121.75	125.00	129.25	130.50	132.25
7.5	114.00	116.00	118.00	121.50	125.00	129.25	132.00	134.50	135.50
8.0	116.75	118.50	120.50	124.25	128.00	132.00	135.00	137.50	139.50
8.5	119.00	121.00	123.00	126.75	131.25	134.50	138.25	141.00	142.50
9.0	121.50	123.50	125.50	129.25	134.50	137.00	141.75	144.25	145.50
9.5	124.00	125.00	128.00	132.00	136.50	141.50	145.00	147.00	148.50
10.0	127.50	128.50	131.50	134.00	138.50	143.00	147.00	149.00	154.00
10.5	128.50	130.50	137.00	137.00	140.50	145.50	150.00	152.50	155.00
11.0	130.50	133.00	134.50	139.50	143.00	144.00	152.50	155.50	157.50
11.5	132.00	134.50	137.00	142.00	146.50	151.00	156.50	159.50	161.00
12.0	135.50	137.00	139.50	145.00	150.00	154.00	158.00	161.50	163.50
12.5	137.50	139.50	143.00	147.50	153.00	157.50	162.50	165.50	167.50
13.0	141.00	142.00	146.00	151.50	157.00	162.50	166.50	169.50	172.00
13.5	144.75	147.50	150.00	155.00	160.00	165.50	170.00	173.00	175.50
14.0	149.00	150.50	153.00	158.50	164.50	169.00	174.00	177.50	178.50
14.5	152.00	154.00	159.50	162.50	167.50	173.50	178.00	180.00	182.00
15.0	154.75	156.50	160.00	165.00	170.00	175.00	179.50	182.00	183.00
15.5	157.50	159.00	161.50	167.00	171.00	176.50	180.25	183.50	185.25
16.0	158.50	160.50	164.00	168.50	173.50	178.00	182.75	185.25	187.50
16.5	160.00	161.50	165.00	169.00	174.50	178.50	183.50	186.50	188.00
17.0	160.50	163.00	165.50	171.00	175.25	180.25	184.50	187.50	188.50
17.5	161.50	164.00	166.00	170.50	175.00	180.25	184.50	187.00	189.00
18.0	162.50	164.50	167.00	171.00	175.50	180.50	185.00	187.00	189.50
18.5	162.50	164.50	167.50	171.50	176.00	181.00	185.50	188.00	189.50
19.0	163.00	165.00	167.50	172.00	176.50	182.00	185.50	188.00	190.00
19.5	163.00	165.00	167.50	172.00	176.50	182.00	185.50	188.00	190.00
20.0	163.00	165.00	167.50	172.00	176.50	182.00	185.50	188.00	190.00

a) If $P(h)<3$, $3 \leq P(\mu) \leq 97$,

(A1) $$STATUIS(\mu) > \frac{100(\mu - \mu_{3-\mathrm{p}})}{\mu_{3-\mathrm{p}}}\% \text{ OBESE}$$

where $\mu_{3-\mathrm{p}}$ is 'gender-specific-age-based mass' corresponding to 3rd percentile — *cf.* Appendix B in (Kamal *el al.*, 2011*b*) for method of calculation. Lower limit of *estimated-adult BMI* could be determined using inequality (A2)**:**

Table B2. Height-for-age percentiles of girls (2 to 20 years)

Percentiles → Ages↓	3	5	10	25	50	75	90	95	97
2.0	78.00	78.50	80.50	82.00	84.50	87.50	88.50	90.50	91.50
2.25	80.00	81.50	83.50	84.50	87.00	88.00	91.50	93.50	94.00
2.5	82.50	83.50	84.50	86.50	87.00	92.50	95.50	96.50	97.00
3.0	86.50	87.00	87.50	91.50	93.50	96.50	99.00	100.50	101.50
3.5	89.50	90.50	92.50	94.50	97.50	99.50	102.50	104.50	105.50
4.0	93.00	93.50	95.50	98.00	100.50	104.00	106.50	108.00	109.50
4.5	95.50	96.50	98.50	101.50	104.00	106.50	109.50	112.00	113.00
5.0	98.50	99.50	101.50	104.50	106.50	110.50	113.50	115.50	116.50
5.5	101.50	103.00	104.50	107.00	110.50	114.00	116.50	119.00	121.00
6.0	105.00	107.00	108.00	110.50	114.50	118.00	121.50	123.50	124.50
6.5	108.50	109.50	111.50	114.50	117.50	121.50	123.00	127.00	128.50
7.0	111.00	113.00	114.50	117.50	121.50	125.00	128.00	131.00	132.50
7.5	114.50	115.50	117.50	121.00	124.50	128.50	132.00	134.50	136.00
8.0	116.50	118.50	120.50	123.50	127.50	131.50	135.00	137.50	138.50
8.5	119.00	120.00	123.00	126.50	130.00	134.50	137.00	141.00	142.50
9.0	121.50	123.00	125.50	129.00	133.50	137.50	141.00	143.00	145.50
9.5	123.50	125.50	127.50	131.00	135.50	139.50	144.00	146.00	147.00
10.0	125.50	127.00	130.00	133.50	138.00	142.00	146.50	149.00	151.00
10.5	127.50	129.50	132.00	136.00	141.00	146.00	149.50	152.00	155.00
11.0	130.00	132.00	135.00	139.00	144.00	149.00	153.00	155.50	158.00
11.5	133.50	135.50	138.50	142.00	147.00	152.00	157.00	159.50	161.50
12.0	136.50	138.50	141.00	146.00	152.00	156.50	161.00	163.50	165.00
12.5	140.50	142.50	145.00	150.00	154.00	159.00	163.00	166.00	167.50
13.0	143.50	145.50	147.50	152.50	157.50	161.50	165.50	168.50	170.00
13.5	146.00	148.00	150.50	154.50	159.00	164.50	167.50	170.00	171.50
14.0	147.50	150.00	152.50	156.00	160.00	165.00	168.50	170.50	173.00
14.5	148.50	150.50	153.00	157.00	161.00	165.50	169.50	172.00	174.00
15.0	150.00	151.00	153.50	157.50	159.50	165.50	170.00	172.75	174.25
15.5	150.25	151.75	153.50	158.50	162.50	167.00	170.50	173.25	174.50
16.0	150.50	152.50	154.50	158.00	162.50	167.00	170.50	173.50	174.50
16.5	151.00	152.50	154.75	158.50	162.50	167.50	171.00	173.50	174.75
17.0	151.25	152.50	154.75	158.75	162.50	167.50	171.00	173.50	175.25
17.5	151.50	152.50	154.75	159.00	162.50	167.50	172.50	173.50	175.25
18.0	151.50	152.50	154.75	159.00	163.50	167.50	172.50	173.50	175.25
18.5	151.50	152.50	154.75	159.00	163.50	167.50	172.50	173.50	175.25
19.0	151.50	152.50	154.75	159.00	163.50	167.50	172.50	173.50	175.25
19.5	151.50	152.50	154.75	159.00	163.50	167.50	172.50	173.50	175.25
20.0	151.50	152.50	154.75	159.00	163.50	167.50	172.50	174.00	175.25

(A2) $$BMI_{\text{est-adult}} > \frac{\mu_{\text{est-adult}}}{h^2_{\text{3-p-adult}}}$$

Here, $h_{\text{3-p-adult}}$ represents, height corresponding to 3rd percentile, for adults.

b) If $P(h)<3$, $3 \le P(h_{MP}) \le 97$, $STATUS(h)$ may be computed using regular formula and the child is STUNTED.
c) If $P(h)<3$, $P(\mu)>97$ then $STATUS(\mu)$ is, still, determined using (A1). Inequality (A3) gives the lower limit of *estimated-*

Table B3. Weight-for-age percentiles of boys (2 to 20 years)

Percentiles → **Age↓**	**3**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**97**
2.0	10.50	10.75	11.00	12.00	13.00	14.00	14.50	15.50	16.00
2.5	11.00	11.50	12.00	12.50	13.50	14.50	15.50	16.30	17.50
3.0	11.75	12.00	12.50	13.50	14.50	15.50	16.50	17.50	18.00
3.5	12.00	12.50	13.00	14.50	15.50	16.50	17.50	18.50	19.50
4.0	13.00	13.50	14.00	15.50	16.50	17.50	19.00	20.00	21.00
4.5	13.50	14.00	14.50	16.00	17.00	19.00	20.50	22.00	23.00
5.0	14.50	15.00	15.50	17.00	18.00	20.00	22.00	23.50	24.50
5.5	16.00	16.50	17.00	18.50	19.50	21.50	24.00	25.00	26.50
6.0	16.50	17.00	18.00	19.00	20.50	23.00	25.50	27.00	28.00
6.5	17.00	17.50	18.50	19.50	22.50	24.00	27.00	28.50	30.00
7.0	18.00	18.50	20.00	21.00	23.00	25.50	27.50	30.50	32.50
7.5	19.00	19.50	20.50	22.00	24.50	27.00	30.50	32.50	34.50
8.0	20.00	20.50	21.50	22.50	25.50	29.00	32.00	34.50	37.00
8.5	21.00	21.50	22.50	24.50	26.50	30.50	34.50	38.00	40.00
9.0	22.50	23.00	23.50	25.50	28.50	31.75	36.50	40.00	42.50
9.5	23.00	23.50	24.50	27.25	30.00	34.00	39.00	42.50	45.50
10.0	24.00	24.50	26.50	28.00	31.75	36.25	41.50	45.50	49.50
10.5	25.50	26.50	27.00	30.00	33.50	38.00	44.50	49.00	52.50
11.0	26.50	27.00	28.50	31.50	36.00	41.00	47.00	51.50	55.50
11.5	28.00	29.00	30.50	33.50	38.00	44.00	51.00	55.50	59.00
12.0	29.00	30.50	31.75	35.50	40.50	46.00	53.50	59.00	62.50
12.5	30.50	32.50	34.50	38.00	42.50	50.00	57.00	62.50	66.00
13.0	32.50	33.50	36.50	40.50	45.50	52.00	60.00	65.50	70.00
13.5	36.50	38.00	41.00	43.00	48.00	55.50	64.00	69.00	73.00
14.0	37.00	38.00	41.00	45.50	51.00	58.00	66.00	73.00	76.00
14.5	38.00	41.00	43.00	48.00	54.50	61.50	69.50	75.00	80.50
15.0	41.30	42.50	45.25	50.00	56.25	63.50	72.50	78.00	82.50
15.5	43.50	45.50	47.00	52.50	59.00	67.50	75.50	81.50	86.00
16.0	45.50	47.00	50.00	54.50	60.50	69.00	77.50	83.50	89.00
16.5	47.50	49.00	52.50	56.00	63.00	70.50	80.00	86.50	91.50
17.0	49.00	51.00	53.50	58.00	64.00	72.50	82.00	88.50	93.00
17.5	50.00	52.00	54.50	60.00	66.00	74.00	83.00	90.50	96.00
18.0	51.50	53.50	55.50	60.50	62.50	71.50	85.00	91.50	97.00
18.5	52.50	54.00	56.50	61.50	68.00	76.50	86.50	93.00	98.00
19.0	53.50	54.50	56.50	62.50	69.50	77.50	87.50	93.50	99.00
19.5	54.00	55.50	58.00	63.00	70.00	78.00	88.00	94.50	99.75
20.0	54.50	56.00	58.25	63.25	70.50	79.00	89.00	96.00	101.00

adult BMI:

(A3)
$$BMI_{\text{est-adult}} > \frac{\mu_{97\text{-p-adult}}}{h^2_{3\text{-p-adult}}}$$

where $\mu_{97\text{-p-adult}}$ is the mass corresponding to 97^{th} percentile, for adults.

d) If $P(h_{\text{MP}}) > 97$ and $P(h) \leq 97$, then we would have

Table B4. Weight-for-age Percentiles of girls (2 to 20 years)

Percentiles → **Age↓**	**3**	**5**	**10**	**25**	**50**	**75**	**90**	**95**	**97**
2.0	10.00	10.00	10.50	11.25	12.00	13.00	14.00	14.50	15.00
2.5	10.50	10.50	11.50	12.00	13.00	14.00	15.25	16.00	16.50
3.0	11.50	11.50	12.00	13.00	14.00	15.00	16.50	17.25	17.50
3.5	12.00	12.00	13.00	13.50	14.50	16.00	17.00	18.50	19.00
4.0	12.25	13.00	13.50	14.50	16.00	17.25	19.00	20.50	21.50
4.5	13.50	14.00	14.50	15.25	16.50	18.50	20.50	21.50	22.50
5.0	14.00	14.50	15.25	16.25	18.00	19.75	22.00	23.50	25.00
5.5	15.00	15.25	16.25	17.00	19.00	21.00	23.50	25.50	26.50
6.0	16.00	16.50	17.00	18.50	20.00	22.50	25.50	27.25	28.50
6.5	16.50	17.25	18.25	19.50	21.50	24.00	27.25	29.00	30.75
7.0	17.50	18.25	19.00	20.50	22.50	25.50	28.50	31.00	33.00
7.5	18.50	19.00	20.00	20.25	24.00	27.25	31.00	33.50	34.50
8.0	19.50	20.00	21.00	23.00	25.50	29.00	33.00	36.00	39.00
8.5	20.50	21.00	22.00	24.00	27.00	31.00	35.50	38.50	41.00
9.0	21.50	22.00	23.50	25.50	29.50	33.00	37.50	41.50	44.50
9.5	22.50	23.50	24.50	27.25	30.75	35.25	40.00	44.25	47.25
10.0	23.50	24.50	26.25	27.00	32.75	37.25	43.50	48.00	51.00
10.5	25.50	26.25	27.25	30.75	34.50	40.00	46.25	51.75	54.50
11.0	26.50	27.50	29.50	32.75	37.25	42.50	49.50	54.50	58.25
11.5	28.25	29.50	31.00	34.50	39.50	45.25	52.75	58.25	62.00
12.0	30.00	31.50	33.00	36.25	41.75	48.00	55.50	61.00	65.25
12.5	31.75	32.50	34.50	38.25	43.50	50.75	58.25	64.50	68.75
13.0	33.00	34.50	36.25	40.00	45.25	52.75	61.50	67.25	72.00
13.5	35.00	36.00	38.00	41.75	47.00	54.50	63.50	69.75	74.50
14.0	36.50	37.75	40.00	43.50	49.50	56.50	65.50	73.00	77.00
14.5	38.00	39.50	41.75	44.75	54.75	58.25	67.25	73.75	79.75
15.0	39.75	40.75	42.50	46.25	52.00	59.50	69.50	75.25	81.50
15.5	40.75	41.75	44.00	47.75	53.00	60.50	69.50	77.00	82.50
16.0	41.50	43.00	45.00	48.75	54.00	61.50	70.50	78.00	84.50
16.5	42.50	43.50	45.75	49.00	54.50	62.00	70.75	79.00	85.25
17.0	43.00	44.50	46.25	50.00	55.25	52.50	71.75	79.50	86.25
17.5	43.50	45.00	46.75	50.50	55.50	62.75	72.50	79.75	86.75
18.0	44.50	45.25	47.25	50.75	56.25	63.50	72.50	80.50	87.50
18.5	44.75	46.00	47.50	52.00	56.50	64.00	73.50	81.75	88.00
19.0	44.75	46.00	48.00	51.75	57.00	65.00	74.50	82.00	88.00
19.5	45.00	46.50	48.00	52.00	57.75	65.50	75.00	82.50	88.75
20.0	45.25	46.50	48.25	52.25	58.25	66.00	75.25	82.50	88.75

(A4) $$STATUS(h) > \frac{100(h_{97-p} - h)}{\mathrm{h}_{97\text{-p}}}\,\%\ \text{STUNTED}$$

h_{97-p} symbolizes 'gender-specific-age-based height' corresponding to 97th percentile — *cf.* Appendix B in (Kamal *et al.*, 2011*b*).

e) If $P(\mu)$>97, $3 \le P(h) \le 97$, $STATUS(\mu)$ may be computed using regular formula and the child is OBESE. $BMI_{\text{est-adult}}$ is given by

(A5) $$BMI_{\text{est-adult}} > \frac{\mu_{\text{97-p-adult}}}{h^2_{\text{3-p-adult}}}$$

f) If $P(\mu) < 3$, $3 \le P(h) \le 97$, $STATUS(\mu)$ may be computed using regular formula and the child is WASTED. Inequality (A6) gives the upper limit of *estimated-adult BMI*:

(A6) $$BMI_{\text{est-adult}} < \frac{\mu_{\text{3-p-adult}}}{h^2_{\text{est-adult}}}$$

g) If $P(h_{\text{MP}}) < 3$, $P(h) \ge 3$, h_{MP} is not computable, so we'll replace h_{MP} in the formula for $STATUS(h)$ computation with $h_{\text{3-p}}$, current-age height corresponding to 3rd percentile, as shown below

(A7) $$STATUS(h) > \frac{100(h - h_{\text{3-p}})}{h_{\text{3-p}}}\% \text{ TALL}$$

h) If $P(\mu)<3$, $P(h)>97$,

(A8) $$STATUS(\mu) > \frac{100(\mu_{\text{97-p}} - \mu)}{\mu_{\text{97-p}}}\% \text{ WASTED}$$

The formula for the upper limit of *estimated-adult BMI*, in this case is**:**

(A9) $$BMI_{\text{est-adult}} > \frac{\mu_{\text{3-p-adult}}}{h^2_{\text{97-p-adult}}}$$

where $h_{\text{97-p-adult}}$ is the height (in *meters*) corresponding to 97th percentile. $STATUS(h)$ is worked out using the same formula as mentioned in equation (A7).

i) If $3 \le P(\mu) \le 97$, and $P(h)>3$, the formula for $STATUS(\mu)$ mentioned in (A8) is still valid. *Estimated-adult BMI* may be computed from:

(A10) $$BMI_{\text{est-adult}} > \frac{\mu_{\text{est-adult}}}{h^2_{\text{97-p-adult}}}$$

where $h_{\text{97-p-adult}}$ is the height (in *meters*) corresponding to 97th percentile. If $P(h_{\text{MP}})$ lies in the interval [3,97], $STATUS(h)$ may be computed using regular formula and the child is TALL.

Growth-and-Obesity Profiles of some children and adults, representing extreme cases, who came to our practice are uploaded as **Additional File 2** — **Extreme Cases:** http://www.ngds-ku.org/Papers/J30/Additional_File_2.pdf

APPENDIX B: GROWTH TABLES

These Growth Tables B1-4 (pages 246-249) were generated from growth charts released by CDC (Center for Disease Control). All ages are reported in *years*, heights in *cm* and masses in *kg*.

ENDNOTES

[a]This e-mail was sent to one of the students of SAK, Rafia Imtiaz (BS, Applied Mathematics, University of Karachi, Class of 2011) by David Ludwig, in response to her queries.

[b]Maintaining optimal weight-for-height is encouraged by *Allah Subhanahu Taāla* by stating that one should exercise discretion in spending, neither to spend too much like burning candles at both ends nor become stingy (Al-Quran 17: 29 — *Surah Bani-Israel* or *Suratul-Asra*)

[c]According to Syed Ismail Raza Zabih Tirmizi, this is not, really, related to physical maturity, but developmental milestones achieved (Kamal, 1998; 2002), in particular, sexual knowledge of the child.

[d]The first number gives the sequential order of chapter (*surah*), as it appears in the Holy Quran (sacred book of Muslims), whereas the second one indicates the number of verse (*ayah*) in a given chapter; actual name of chapter, is, also, mentioned for easy reference.

[e]Safidddin Sidddiqui of BBS, the Aga Khan University Medical College suggested that ICP model should be called FICP model.

[f]The entire life of the spiritual leader of Muslims, Our Holy Prophet, Muhammed (peace and blessings be upon him) is practical implementation of this mindset.

[g]This is in accordance with the saying of *Rahmat-ul-lil-Alameen* (Mercy for the worlds**:** Al-Quran 21**:**107 — *Suratul Anbiyāa*), Muhammed (peace and blessings be upon him) that a Muslim should be seeking knowledge from cradle (*i. e.*, mother's lap) to grave.

[h]According to *DAWN* report (Saturday, August 4, 2012, p. 3) British authorities looked into hundreds of cases of forced marriages in year 2011, some of them ended up in honor-killings.

[i]This work proposed a mathematical definition of *brain death*.

[j]*Allah Subhanahu Taāla* states, while describing the affairs of children of Israel, that their hearts hardened like a rock and even more than that. However, there are some rocks from which rivers gush forth. There are others, which when split asunder, bring water and some of them even sink for fear of *Allah Izz-o-Jal* (Al-Quran 2**:** 74 — *Suratul-Baqarah*). Such is the desired state to be created in the hearts of marriage partners**:** feeling, sharing, caring and accepting bounties as well as hardships of life together.

[k]Scoliosis (and associated trunk deformities, kyphosis and lordosis — the last one may pose a diagnostic challenge because of body-structure changes associated with later stages of pregnancy) detection in pregnant female is a tricky matter as Adam's forward bending test or AP- and lateral-X rays of the entire spinal column (external auditory meatus to hip joint, in the anatomical position) can not be employed, the first one carries the risk of miscarriage and the second one radiation damage to fetus. The method for expected mothers is, therefore, completely different from that in practice for children and adolescents (Kamal, 1997*b*; Kamal *et al.*, 1996; 1998). Therefore, gynecologists need to be trained to do a thorough visual examination of back and side (the first one to look for left-right asymmetries in the frontal plane and the second one to look for abnormal spinal curvatures in the sagittal plane) keeping in view *Cumulative-Scoliosis-Risk Weightage (CSRW)* determined on the basis of school examinations of the patient (Kamal, 2012*b*). If this examination is supplemented by moiré fringe topography, false positives may be reduced (Akram and Kamal, 1991; Kamal, 1997*a*; 1998*a*; 2008; 2009*a*; Kamal and Lindseth, 1980). Such a checkup must be performed, when a female comes for the very first visit, as part of post-marital (complete) physical examination and psychological counseling, possibly before becoming pregnant. This way most of the above issues might be bypassed and a newly married female could be, appropriately, advised for the best course of action. The authors recommend mandating these procedures through medical-practice law, as part of the licensing procedure, in the third-world countries, backed by WHO (World Health Organization) recommendation. In North America, there seems to a tendency to sue the attending physician for malpractice, if the examinations are not performed properly or certain essential checks are left out.

. [l]The term *gynecological orthopedics (GO)* is referred to very rarely in literature. Only 2 references, whose titles contain this term, were found during a google search (Martius, 1959; Scheuer, 1960).

. [m]*JCI* stands for *Joint Commission International*; SAK was involved in the accreditation process of the Aga Khan Hospital, while serving as Sessional Faculty at the Aga Khan University Medical College, Karachi.

[n]Shahid (2012) states, "Infants and children can, only, be detected for growth falter when the comparison is made by those standards used, internationally." The authors are of the opinion that the Pakistani standards need to be developed, as patchwork from standards of other countries has been inadequate in the past.

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ADDITONAL NOTES (*related to this paper, but not part of the published manuscript*)

i) According to Finlay *et al.* (2012), children of those mothers, aged less than 20 *years*, are at highest risk of death. Moreover, firstborns to mothers, who had their first children in their early twenties, suffer from stunting, diarrhea and anemia. These health risks of first child are minimized if mother's age is 29 *years*. Therefore, as regards child health, best age for a woman to become a mother lies between 27 and 29 *years*.

ii) DAWN (Food-security plan stalls after ex-PM's exit, Tuesday, July 31, 2012 — Metro and South page) has published maps of Sindh Province of Pakistan, which show district-wise percentage of child stunting and wasting, according to National Nutritional Survey of Pakistan. These graphs show the top slots for child stunting (Nawabshah, Sukkur, Thatta and Umerkot) and wasting (Badin, Mirpurkhas, Noshero Feroz and Tharparker). A two-day (Sindh, multi-sectorial, nutritional) workshop was held in Karachi on July 30, 31, 2012, which emphasized on *integrated-nutrition policy*, political commitment, uninterrupted flow of funds, in addition to strong monitoring and evaluation arrangements to deal with the issue of malnutrition (*DAWN*, Need for integrated-nutrition policy stressed, Wednesday, August 1, 2012, p. 15)

iii) A recent UNDP report on human-development index pointed out 3 major gaps in the third-world countries (Salahuddin, 2012)**:** *knowledge gap*, *freedom gap* and *status-of-women gap*. This paper attempted to address the last issue in the context of underage and forced marriages.

. *iv)* In his message for *the International-Girl-Child Day*, United Nations Secretary General Ban Ki-moon remarked, "Education for girls is one of the best strategies for protecting girls against child marriage". Thursday, October 11, 2012, was designated as this day by a UN-General-Assembly Resolution adopted in December 2011, theme chosen for this year was *Ending Child Marriage*. However, a lot of efforts are needed for this message to be transformed into reality. Back at home, government has failed to set up *the Sindh Child Protection Authority*, even after passage of its act a year ago in June 2011, this fact brought to notice by participants of a seminar, "Status of Child Rights in Provincial Protection System after the Eighteenth Amendment", held in Karachi on Monday, October 8, 2012, organized by the Society for the Protection of Rights of the Child (SPARC).

v) Khan (2014) is of the opinion that with child marriages rampant among unprivileged families in rural areas, there is a much greater chance of kids from such backgrounds to fall prey to mental illnesses (the authors have expressed the same opinion in this paper). He goes on to quote Dr. M. Riaz of the Bacha Khan Medical College, "If the child brides and grooms belong to families that are economically insecure, they confront the risk of mental disorder and psychological trauma". Jalil (2014) has quoted statistics given by an NGO, *Shirkat Gah*, according of which, close to half of the Pakistani women are married before their 18th birthday and 9% become pregnant in the age range 15-19 years. She further stated that worldwide, approximately 60 million girls are married under the age of 18. Human-rights activist I. A. Rehman observes that patriarchy and feudalism, rather than *Sharia* laws, are behind such serious social crimes. Earlier, Nadia (2013) has taken up the case of child marriage in our society. According to her, "Sindh has the highest rates of underage marriage and underage maternity." In this context, it is a sigh of relief that Sindh government is considering amending old child marriage laws, which should enforce stricter penalty and punishments for this offence. However, there is, still, long way to go in getting the bill related to child marriages approved from National Assembly of Pakistan (Shah, 2014). The real-life accounts of victims of childhood marriage, some as young as eight-year old, from Jacobabad and Matiari districts of Sindh, Pakistan have been collected and published in book form by the Rutgers WPF and HANDS (*DAWN*, Book on childhood marriages launched, Thursday, February 27, 2014, p. 18). Sindh Assembly, recently, passed the Sindh Child marriages Restraint Bill, 2013, that places a ban on marriage of under-18 children (Ghori, 2014)

vi) A follow up of the child-bride story published by *Readers Digest* (Ali and Minoui, 2012) appeared, recently, in *DAWN* (Sheffer, 2013). According to Nujood Ali (the main character behind the story), "My father has spent all the money on getting married twice again." Her father, who has since then sold her younger sister to a man twice her age, has misused the royalties from the story, which were meant to pay for the girl's schooling. The authors reco-mmend that a fresh charter of child rights be devised to address such issues, with the help of organizations like *Human Rights Watch* and *Transparency International* (the first author is convener of a subcommittee of the Edu-cation Committee, Transparency International Pakistan). This should become part of UN Charter. In order to qualify for aids and grants from international organizations, the recipient country must be compelled to be a signatory of such charter.

vii) The first author has prepared (in collaboration with the second author) parent-friendly-one-page handouts providing guidelines to increase height, manage weight, overcome vitamin-D deficiency (Kamal, 2013*a-c*) and look for early-warning signs indicating possible presence of scoliosis (Kamal, 2012*b*). During *the First Conference on Anthromathematics*, papers were presented on the above-mentioned topics (Kamal *et al.*, 2013*a-c*).

viii) Low levels of spontaneous activity are observed in many obese children (Brukner *et al.*, 2002). Kamal and Khan (2013) have prepared suggestions to increase fitness levels of primary-school children.

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