GROWTH-AND-OBESITY ROADMAPS 5.0 FOR CHILDREN OF STILL-GROWING PARENTS — THE ELEVENTH-GENERATION SOLUTION OF CHILDHOOD OBESITY-AND-MALNUTRITION

Syed Arif Kamal*

Founding Project Director, The NGDS Pilot Project, PO Box 8423, Karachi 75270, Pakistan; profdrakamal@gmail.com

ABSTRACT

This work is a generalization of Growth-and-Obesity Scalar- and Vector-Roadmaps 4.5 to construct roadmaps of sons and daughters, whose parents are still gaining height, which means that mother is under-19 and father is under-21. In order to compute target (adult-mid-parental) heights of children, one needs to replace heights of biological mother and biological father by their respective estimated-adult values. Growth-and-Obesity Roadmap 5.0 is different from Growth-and-Obesity Roadmap 3.0 in the computation of reference height, which is a maximum of measured height as well as median, current-age-army-cut-off and current-age-mid-parental heights (last 3 gender-specific). Simulated data of a still-growing couple and their twin son and daughter are utilized to demonstrate the procedure, in which 6 monthly recommendations to increase height and manage mass (weight) are given. A mass range is provided in place of a single value, so that it would be easier to achieve targets. Ranges are evaluated based on the last-checkup values of reference percentile and reference-*BMI*-based-optimal-mass percentile. Height-gain-target-achievement index and mass-management-target-achievement index have been computed at the time of 2nd checkup based on measured values at that time and values recommended from the 1st checkup. Nutritional status at each checkup is determined based on 23 categories, safe sun-exposure timings for children as well as their parents, for the next 6 *months* from 2nd checkup, given for the city of Karachi. Graphical representations of CDC percentile-of-height and CDC percentile-of-mass for twin boy and twin girl are given, which illustrate regions showing trends of obesity, wasting and optimal-mass management.

Key words: Estimated-adult height • estimated-adult-specific *BMI* • forced marriage • height-gain-target-achievement index • instantaneous obesity/wasting/tallness/stunting • mass-management-target-achievement index • modified-scaled percentiles • true obesity/wasting/tallness/stunting • underage marriage

LIST OF ABBREVIATIONS

***BMI*: B**ody-**M**ass **I**ndex • **CDC: C**enters for **D**isease **C**ontrol and Prevention • **COVID-19: CO**rona**VI**rus **D**isease 20**19** • **HQ: H**ead **Q**uarters (5 Corps) • **MO-CORD: M**iss**O**uri **C**hildhood **O**besity **R**esearch **D**emonstration • **NCHS: N**ational **C**enter for **H**ealth **S**tatistics • **NGDS:** The **N**ational **G**rowth and **D**evelopmental **S**tandards for the Pakistani Children • **NORE: N**aval **O**fficers **R**esidential **E**state • **OptiMA: Opti**mizing the Management of Acute **MA**lnutrition • **P: P**ercentile • **PAF: P**akistan **A**ir **F**orce • **SGPP:** The **S**ibling **G**rowth **P**ilot **P**roject • **STOP: S**cience and **T**echnology in Childhood **O**besity **P**olicy • **WHO: W**orld **H**ealth **O**rganization

Units: *cm* — centimeter(s) • *ft* — foot (feet) • *in* — inch(es) • *kg* — kilogram(s) • *lb* — pound(s) • *m* — meter(s) • *µg* — microgram(s) • *oz* — ounce(s)

Conversion Factors: 1 *ft* = 12 *in* • 1 *in* = 2.54 *cm* • 1 *kg* = 2.205 *lb* • 1 *lb* = 16 *oz*

INTRODUCTION

This work generalizes Growth-and-Obesity Scalar- and Vector-Roadmaps 4.5 to construct Growth-and-Obesity Scalar- and Vector-Roadmaps 5.0 of children and adolescents, whose parents are still growing, *i. e.*, mother has not reached her 19th birthday and father not reached his 21st birthday, to generate the eleventh-generation generation solution of childhood obesity-and-malnutrition. This is accomplished by replacing heights of biological father and biological mother with their respective estimated-adult values to determine target height. The challenge of modeling childhood obesity-and-malnutrition is not the same as

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*Meritorious Professor Dr. Syed Arif Kamal, PhD (Neuroscience); MA, Johns Hopkins, Baltimore, MD, United States; MS, Indiana, Bloomington, IN, United States; Ex-Acting Vice Chancellor and Ex-Dean, Faculty of Science, University of Karachi • *homepage*: https://www.ngds-ku.org/kamal • *the NGDS Pilot Project URL*: https://ngds-ku.org • *SGPP link*: https://www.ngds-ku.org/ngds_URL/subprojects.htm#SGPP

Underage	Emotional imbalance, retardation of mental capabilities, effect on physical growth
Late	Comes with maturity and responsibility; but may be associated with subsiding of vitalities
Forced	Pushed into relationship without consent, has similar consequences and repercussions as underage marriage
Love	May appear charming, but most of the time results in broken marriages or life-partner abuse/murder
Arranged	Looks like an optimal solution, avoiding both extremes, as long as stakeholders are taken into confidence

Fig. 1**.** Types of marriages discussed elsewhere (Kamal and Jamil, 2012; Kamal *et al.*, 2020 — Table 4)

adult obesity-and-malnutrition. With the passage of time, a child is picking-up height as well as managing (putting-on or shedding-off) weight. If an intervention is advised based on measured height and weight at the time of checkup, without taking into account of the height gained within the next half-a-*year*, the child may become wasted at the end of half-a-*year* by losing too much weight.

UNDERAGE AND FORCED MARRIAGES

Underage marriage is, also, termed as *very-young marriage*, when the girl or the boy has not even entered teen years. This is the time of enjoying the life, getting basic education and involving in sport and social activities. Very common in impoverished families due to settlement of family feuds, protection of girl or economic considerations, such an arrangement makes the young wife not capable to fulfill her responsibilities as manager of household. In addition to emotional imbalance (the young couple may not be mentally able to cope with fatigue of raising a toddler and, therefore, at times getting involved in child physical abuse), these marriages may, possibly, retard mental capabilities of the young couple as well as effect physical growth and both married boy and married girl might not be able to attain estimated-adult height. Arifin *et al.* (2020) investigated the legal and the social aspects of right to education, in particular, for females subjected to underage marriages (child marriages) in Indonesia. This research confirms that underage marriage is driven by many factors; the leading one is economic conditions. Gastón *et al.* (2019) discusses child marriage from the perspective of boys utilizing data available from 82 countries during the past 10 *years*. They found out that the countries with the highest prevalence of underage marriage among boys are geographically diverse and differ from the countries where the practice is most common among girls. Mikhailin and Ivanova (2019) determined features of the state of newborns of minor mothers, who gave birth of their children in St. Petersberg during 2004-2014. They found that in children of underage mothers the hypotrophy of the newborn was more significantly observed as well as inflammatory diseases specific to the perinatal period. Ozer *et al.* (2014) that minor motherhood, not only, have medical implications, but also, pose a multi-dimensional problem encompassing social, economic, traditional, religious, and legal issues. Villa-Cruz *et al.* (2019) state that adolescent pregnancy a major problem, as there are social factors involving underage pregnancy with related consequences. They searched the level of education at the time of first pregnancy, and correlated with the educational level of the parents. According to Prettitore (2015), the rate of underage marriage in girls is different across the MENA (Middle East & North Africa) region. Take the example of Jordan. It is located into a country cluster (Algeria, Lebanon, and Tunisia), where there is low incidence of such marriages, whereas Morocco is situated among the cluster (Egypt, Iran, Iraq, and Syria) having a higher incidence. Yemen is the major outlier. The author is of the opinion that judicial reforms alone banning marriage at a tender age, without giving due attention to social and economic factors, should not be able to decrease instances of such marriages.

Forced marriages are those in which the couple is compelled into a relationship without taking their opinion. Such arrangement ends up with almost similar consequences as under-age marriages. This is the scenario, in which the victims are pushed to begin a fresh life, leaving behind their loved ones (families and friends) as well as their educational and professional careers. Chantler *et al.* (2009) conducted a qualitative study of force marriages in England and offered a multidimensional view challenging 4 key points. They suggested measures to support females experiencing forced marriages. Clark and Richards (2008) discuss forced marriages in the context of France and England and state that such marriages create very complex and sensitive problems, which include social, gender, ethnic religious and economic issues. Ouattara *et al.* (1998) worked for *the Forum on the Rights of Girls and Women in the Marriage* and compared case studies from Nepal, West Africa and India. They argued that cultural practices harming females must be addressed separately.

Figure 1 lists types of marriages discussed by the author in a 2012 paper (Kamal and Jamil, 2012 — Underage and Forced Marriages**:** Implications) and summarized in a 2020 work (Kamal *et al.*, 2020 — Table 4).

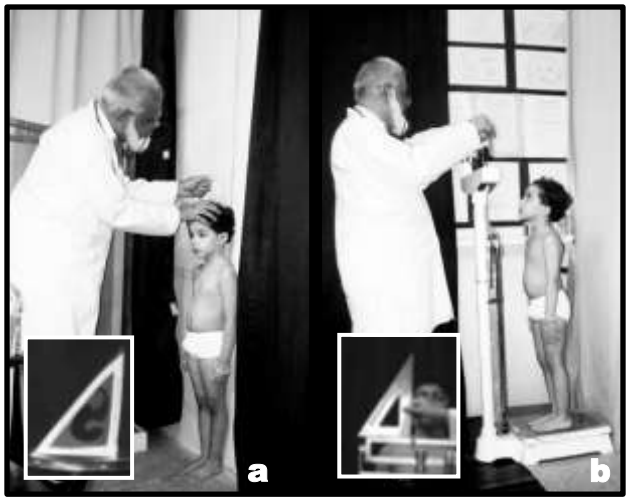


Fig. 2**.** Measuring (*a*) height and (*b*) mass (weight) of a 3-*year* old girl in Growth-and-Imaging Laboratory

MONITORING OF HEIGHT AND WEIGHT OF CHILDREN

One of the essential measurements during the younger years is standing height (stature), indicating tissue synthesis. Height is easy to obtain and is a measure of life-course as well as long-run health. However, it is important that height pick up should be proportionate to give the feel of a properly-developed personality. Failure to gain height in childhood is the first indicator that body systems are not functioning properly and needs to be addressed at an early stage. Another important measurement, which has significance in all age ranges, is mass (weight). If a child fails to put on mass (weight) or suffers from a rapid loss of weight during tender years, it may signal a deeper problem, requiring a comprehensive physical and psychological examination. Both underweight and overweight conditions in childhood have serious implications, which affect quality of life in adulthood and old age.

Regular monitoring of heights and weights of all school-going students (twice a *year*), younger ones undressed to short underpants, all clothing above the waist removed (older students in school uniforms), barefooted and bareheaded, should be compulsory in all public and private (civilian) schools of Pakistan as well as institutions run by the Armed Forces of Pakistan starting from the time, when the pupil enters school or transfers from another school. These measurements are taken as per internationally-agreed, laid-down procedures documented in the NGDS manual (Kamal, 2016), employing step-by-step protocols illustrated through labeled photographs (Kamal *et al.*, 2021*a*, Additional File 1). Mass- and height-measurement instruments are calibrated using standard 2-*kg* mass and 100-*cm* ruler at the start of each daily session along with recording of zero errors. Least count of height measurement was reduced from 0.1 *cm*, (engineering tape mounted on wall) to 0.01 *cm* (Vernier scale) in 2010 (Kamal, 2010) and further to 0.005 *cm* (enhanced-Vernier scale) in 2016 (Kamal *et al*., 2016*b*). Least count of mass measurement was reduced from 0.1 *kg* (beam scale) to 0.01 *kg* (Vernier scale) in 2010 (Kamal, 2010) and further to 0.005 *kg* (enhanced-Vernier scale) in 2016 (Kamal *et al.*, 2016*b*).

For the measurement of standing height (stature) in schools, the pupil is asked to stand in the attention position (breathing in to trap maximum air), chin parallel to floor, touching the mounted engineering tape and asked to align hands with the body, palms touching thighs and heels together (Figure 2*a*). For recording of mass (weight), the student is instructed to step on the beam-scale center in stand-at-ease position, palms on thighs and feet separated, looking straight and fully inhaling (Figure 2*b*).

Field Study — the NGDS Pilot Project

As per directives of Governor Sindh/Chancellor, University of Karachi, a retired Lieutenant General of the Pakistan Army, a team from University of Karachi, led by the author, took up the assignment to establish National Growth and Developmental Standards (NGDS) for the Pakistani children. In 1998, this team initiated the NGDS Pilot Project in 3 institutions administered by the Armed Forces of Pakistan — Army Public School, 'O' Levels, Fazaia Degree College, PAF Base 'Faisal' and Bahria College, NORE I, all located in Karachi, on the basis of letters from the Secretariat of Governor Sindh, bearing numbers GS/2-55/98 (SO-I)/2531, 2530 and 2529, all dated November 25, 1998, addressed to Corps Commander,

HQ 5 Corps, Commanding Officer, NORE I, and Base Commander, PAF Base 'Faisal', respectively. In 2011, a civilian school (Beacon Light Academy, Karachi) was included in the study. Heights and masses of over 1500 students were collected and their Growth-and-Obesity Roadmaps constructed to classify statuses of obesity/wasting/tallness/stunting, assign build (small, medium, big) and determine nutritional status (based on 23 categories).

***Laboratory Study — Sibling Growth Pilot Project* (*SGPP*)**

A family-centered subproject of the NGDS Pilot Project, Sibling Growth Pilot Project (SGPP) monitored health of enrolled families, who visited Growth-and-Imaging Laboratory for checkups along with their 5-10-*year*-old sons and daughters during 2002-2019. Checkups were conducted giving due regard to parents' and their children's comfort, confidentiality, dignity, privacy and safety.

Protocols of the NGDS Pilot Project https://ngds-ku.org and Sibling Growth Pilot Project (SGPP) https://www.ngds-ku.org/ngds_URL/subprojects.htm#SGPP are described in detail elsewhere (Kamal *et al.*, 2016*a*, Additional File 1).

SOLUTIONS OF CHILDHOOD OBESITY-AND-MALNUTRITION

Fowler *et al.* (2021*a*) reviewed and conducted meta-analysis of current applications of technological solutions for childhood-obesity prevention and treatment. Argelich *et al.* (2021) described how pediatric teams intervened to handle obesity in children in the context of STOP Project. Bramante *et al.* (2019) discussed natural experiments for preventing and controlling of obesity in youngsters. Brock *et al.* (2019) described a 3-*year*, mixed-methods case study to adapt, implement and evaluate an evidence-based childhood obesity treatment program. Cheng *et al.* (2022) discussed challenges of predicting child obesity using machine learning. Fowler *et al.* (2021*b*) and Wilfley *et al.* (2021) described the MO-CORD Study Protocol, which meant to translate family-based behavioral treatment for childhood obesity into user-friendly digital package as well as its implementation. This package is to be delivered to low-income families through primary-care partnerships. Hossain *et al.* (2019) identified risk factors for overweight and obesity in children and adolescents in Bangladesh. Ickovics *et al.* (2019) discussed implementation of school-based policies to prevent obesity. Razi and Nasiri (2022) conducted a qualitative study dealing with the concerns of parents about children's overweight and obesity during COVID-19 pandemic.

Acute malnutrition in youngsters is posing a greater challenge in recent years as compared to obesity in children. Such youngsters are weak and hence become susceptible to community- and hospital-based bacteremia (Andersen *et al.*, 2022) as well as tuberculosis (Vonasek *et al.*, 2022). Cazes *et al.* (2022) assessed the impact of integrating severe acute malnutrition and moderate acute malnutrition treatment into a single program. Their study showed that the OptiMA malnutrition treatment protocol was better as compared to the existing Democratic Republic of the Congo National Protocol, when favorable outcomes half-a-*year* after inclusion were considered. Mulugeta and Gebregiabher (2022) assessed the condition of youngsters in Tigray, Northern Ethopia, where armed conflict has been raging since November 4, 2020, resulting in total disruption of humanitarian aid, collapse of health facilities and migration of a significant chunk of population. The consequences are prevalence of preventable severe and moderate acute mal-nutrition in youngsters.

The main challenges in modeling childhood obesity-and-malnutrition may be summarized as**:**

- Management of mass (weight) according to the standing height (stature), computed from Growth-and-Obesity Roadmaps, within the next 6 *months*, so that the child does not become wasted on the basis of recommendations according to the height measured most recently
- Lack of a proper definition of childhood obesity — an attempt was made by the author 6-*year* ago (Kamal, 2017)
- Inability to apply adult *BMI* scales to children; the author introduced estimated-adult *BMI* (Kamal and Jamil, 2012) as well as other indicators (Kamal *et al.*, 2021*b* — Table 1) — *BMI* (Body-Mass Index) renamed from Quartlet Index by Keys *et al.* (1972) and reviewed recently by Kolimechkov and Petrov (2020)

Since 2013, 1st- to 11th-generation solutions of childhood obesity-and-malnutrition have been proposed by the NGDS Team (Kamal, 2022*c*). Detailed descriptions of childhood obesity-and-malnutrition are available elsewhere (Kamal *et al.*, 2021*b* — Solutions of Childhood-Obesity Problem**:** 1st to 9th generation solutions; Kamal, 2022*b* — Solutions of Childhood Obesity-and-Malnutrition**:** 1st to 10th generation solutions). These solu-

Table 1. Solutions of childhood obesity-and-malnutrition proposed by the NGDS Team

Solutions of Childhood Obesity-and-Malnutrition	*Date Proposed*	*First Mention*	*Detailed Description*
The First-Generation Solution	September 4, 2013	Kamal *et al.* (2013)	—
The Second-Generation Solution	September 4, 2014	Kamal *et al.* (2014*a*)	Kamal *et al.* (2015)
The Third-Generation Solution	July 1, 2015	Kamal (2015*b*)	—
The Fourth-Generation Solution	February 13, 2016	Kamal *et al.* (2016*b*)	Kamal *et al.* (2016*a*)
The Fifth-Generation Solution	January 1, 2017	Kamal (2017*a*)	Kamal *et al.* (2017*a*)
The Sixth-Generation Solution	October 1, 2017	Kamal (2017*b*)	—
The Seventh-Generation Solution	October 1, 2018	Kamal *et al.* (2018)	—
The Eighth-Generation Solution	January 1, 2020	Kamal *et al.* (2020)	—
The Ninth-Generation Solution	January 1, 2021	Kamal *et al.* (2021*b*)	—
The Tenth-Generation Solution	October 1, 2022	Kamal (2022*b*)	—
The Eleventh-Generation Solution	April 1, 2023	This work	—

tions have extended-nutritional-status categories from 3 (over-nutrition, under-nutrition, acute malnutrition — existing before 2014) to 23 (Kamal *et al.*, 2021*b* — Figure 8, Tables 4, 5). In addition, a new index termed as 'severity of acute malnutrition' (Kamal, 2015*a*) is broken down further into 3 categories as *mild*, *intermediate* and *extreme*, so that appropriate intervention strategies may be devised (Kamal, 2022*b*). Table 1 lists 1st- to 11th-generation solutions of childhood obesity-and-malnutrition.

YOUNGEST MOTHER IN THE RECORDED HISTORY

The question arises as to the existence of children aged 9.5 *years* or above, whose parents are still gaining height. The youngest mother reported in the medical literature delivered her baby boy through caesarian section at the age of 5.64 *years*. According to medical literature (Barber, 2017), **Marcela Medina de Jurado** of Ticrapo, Castrovirreyna Province, Peru (born**:** September 23, 1933) gave birth to a baby boy, **Gerardo**, on May 14, 1939 at the age of 5 *years* 7 *months* and 21 *days*. When this mother would have been 18-*year* old on September 23, 1951, her son should have been 12 *years* 4 *months* and 9 *days* old (decimal age**:** 12.36 *years*) — a clear example of applicability of Growth-and-Obesity Scalar-Roadmap 5.0. Below are calculations of decimal dates of birth and delivery based on the method reported in Kamal *et al.* (2011)**:**

*Decimal Date of Birth***:** 1933.7287671232876712
*Decimal Date of Delivery***:** 1939.3671232876712329
*Decimal Age***:** 1939.3671232876712329 – 1933.7287671232876712
= 5.638356164383561 *years*
*Age of Son***:** 18.00000000000000 – 5.638356164383561
(when mother celebrated her 18th birthday) = 12.36164383561644 *years*

GROWTH-AND-OBESITY ROADMAPS 5.0

The eleventh-generation-solution of childhood obesity-and-malnutrition, Growth-and-Obesity Vector-Roadmap 5.0 applies to youngsters during the period of early childhood (*Age* < 9.5 *years*), father and mother still picking-up height. In version 5.0, target (adult-mid-parental) height is included for each profile in the height portion (as the target height may be different at each checkup for still-growing parents), instead of writing it on the top, whereas 6 monthly predictions are generated on the basis of fitted parabolic curves, in the same manner as is done for version 4.5.

Color-coding for Growth-and-Obesity Roadmaps 5.0 is the same as that for Roadmaps 4.5 and is given in an earlier publication (Kamal, 2022*b*, Additional File 1). Method of construction of Roadmaps 5.0 is the same as that for Roadmaps 4.5 (Kamal, 2022*b*, Additional File 2), with the only difference that mid-parental-height is not constant, as the parents are still growing and has to be listed separately for each of the checkups.

Growth-and-Obesity Scalar-Roadmap 5.0 applies to parents of still-growing children or the children themselves (target height is again included in the height portion, whereas 6 monthly predictions are generated

Table 2. Roadmap applicability in various age ranges

Age Range	*Periods of Growth*	*Roadmap*	*Stage of Puberty*[μ]	*Tanner Score*
$A < 9.5$ *years*	Earlier childhood	Vector-Roadmap 4.5 & 5.0[⊕]	Prepubertal	1
9.5 *years* $\le A < 12.0$ *years*	Later childhood	Scalar-Roadmap 4.5 & 5.0[⊗]	Peripubertal	2
12.0 *years* $\le A < 13.5$ *years*	Transition	Scalar-Roadmap 4.5 & 5.0	Pubertal	3
13.5 *years* $\le A < 20.0$ *years*	Adolescence	Scalar-Roadmap 4.5 & 5.0	Adolescent	4
$A \ge 20.0$ *years*	Adulthood	Obesity Roadmap 2.6	Adult	5

[⊕] Growth-and-Obesity Vector-Roadmap 4.5 & 5.0
[⊗] Growth-and-Obesity Scalar-Roadmap 4.5 & 5.0
[μ] Stages of puberty are related to Tanner score (Kamal *et al.*, 2017*b* — Table 4; Kamal *et al.*, 2021*a* — Table 3) as well as mathematical definitions of early, delayed, excessively-early, excessively-delayed and precarious puberty (Kamal *et al.*, 2021*a* — Figure 1); age ranges in first column are loosely connected to these stages

on the basis of linear interpolation, in the same manner as is done for version 4.5), during the periods of later childhood, transition and adolescence — ranges given in Table 2.

Instead of using actual heights of parents in the calculations, estimated-adult heights are inserted in the formulae. If $h^{\text{Father}}_{\text{est.–adult}}$ represents estimated-adult height of father and $h^{\text{Mother}}_{\text{est.–adult}}$ estimated-adult height of mother, the formulae for target height, adapted from Tanner *et al.* (1970), take the form (Kamal and Jamil, 2012 — Equations 4*a*, *b*)**:**

$$h^{\text{Son}}_{\text{Target}} = \frac{h^{\text{Father}}_{\text{est.–adult}} + h^{\text{Mother}}_{\text{est.–adult}} + 13}{2} = \frac{h^{\text{Father}}_{\text{est.–adult}} + h^{\text{Mother}}_{\text{est.–adult}}}{2} + 6.5 \quad (1)$$

$$h^{\text{Daughter}}_{\text{Target}} = \frac{h^{\text{Father}}_{\text{est.–adult}} + h^{\text{Mother}}_{\text{est.–adult}} - 13}{2} = \frac{h^{\text{Father}}_{\text{est.–adult}} + h^{\text{Mother}}_{\text{est.–adult}}}{2} - 6.5 \quad (2)$$

where $h^{\text{Son}}_{\text{Target}}$ and $h^{\text{Daughter}}_{\text{Target}}$ are target (adult mid-parental) heights for son and daughter, respectively, in *cm*.

NCHS, WHO, extended, scaled and modified-scaled growth charts and tables have been discussed in detail in a paper published recently (Kamal, 2022*a* — Regular Anthropometry of Children**:** Growth Charts and Tables). For construction of Roadmaps 5.0, extended (Kamal and Jamil, 2014, Additional File 3) and modified-scaled growth tables (Kamal *et al.*, 2021*a* — Equations 6*a*, *b* and 10*a*, *b*) have been used. Nutritional-status categories, included in Roadmaps 5.0, are explained in a previous publication (Kamal *et al.*, 2021*b* — Figure 8, Tables 4 and 5).

Cutoff heights for the Pakistani young men and women wishing to be inducted in the Armed Forces of Pakistan are included in Table 3*a*, extended from a previous work (Kamal and Naz, 2021 — Research Problem) as well as median heights based on a sample of 1666 youngsters (503 boys; 1163 girls) hailing from all provinces of the country are given in Table 3*b*, extended from (Kamal *et al.*, 2021*a* — Table 6). These two heights are critical in generating Roadmaps 5.0. Figures 3*a*, *b* illustrate sections of profile portion of Roadmaps 5.0.

Table 3*a*. Cut-off heights for the Pakistani youth wishing to opt for the military and the paramilitary occupations

Adult-Army-Cut-off Heights and the Corresponding Percentiles	*Boys* 🚹	*Girls* 🚺
Height (*ft-in*)	5 *ft* 4.00 *in*	5 *ft* 2.00 *in*
Height (*cm*)	162.56	157.48
CDC Percentile-of-Height[ω]	2.72^{P}	19.36^{P}
Scaled Percentile-of-Height	3.82^{P}	25.86^{P}
Modified-Scaled Percentile-of-Height	3.45^{P}	25.77^{P}

[ω]Values used in calculations are $2.718014592103645\ldots^{\text{P}}$ (boys) and $19.35609323536863\ldots^{\text{P}}$ (girls)

Table 3*b*. Median heights for the Pakistani young adults

Adult-Median Heights and the Corresponding Percentiles	*Boys* 🚹	*Girls* 🚺
Height (*ft-in*)	5 *ft* 9.07 *in*	5 *ft* 3.26 *in*
Height (*cm*)	175.43	160.69
CDC Percentile-of-Height$^{\eta}$	43.21^{P}	34.85^{P}
Scaled Percentile-of-Height	53.44^{P}	44.31^{P}
Modified-Scaled Percentile-of-Height	50.00^{P}	50.00^{P}

$^{\eta}$Values used in calculations are 43.21272955^{P} (boys) and 34.85247886^{P} (girls)

SAMPLE ROADMAPS 5.0 (CASE OF H. FAMILY)

The case of H. Family was first given in Kamal and Jamil (2012), which contained Growth-and-Obesity Profiles 3.0 of both twin children (Z. H. and T. H.) for a single checkup. Eight (8) *years* after the publication of this paper, Growth-and-Obesity Roadmaps 3.0 were constructed (Kamal *et al.*, 2020). In this paper,

Header

*Added in Actual Report***:** Name (in place of initials) • SGPP Identification Number (actual) • Father's Name • Mother's Name • Name of School • GR (General Register) Number • Blood Group • Cell Number • e-mail Address • Paper-Mail (Postal) Address

*Sample Report***:** Initials • SGPP Identification Number (both initials and identification number camouflaged to protect identity) • Gender • Date of Birth (*year-month-day*) • Gender-Specific-Adult-Army-Cut-off Height (*cm*) — corresponding CDC percentile in parentheses • Gender-Specific-Adult-Median Height (*cm*) — corresponding CDC percentile in parentheses

Vital Statistics

*Added in Actual Report***:** Photograph (of the actual child) • Scanned Signatures (actual) • Section (along with class) • Dress Code • Behavior Code

*Sample Report***:** Photograph (not showing the actual child) • Scanned Signatures (camouflaged initials in place of actual signatures to protect identity) • Class • Date of Checkup (*year-month-day*) • Time of Checkup (*a. m./p. m.*) • Age (*year-month-day*) • Age (*decimal year*)

Height Data

Height (*cm*) • Height (*ft-in*) • CDC Percentile-of-Height • Modified-Scaled Percentile-of-Height • Current-Age-Army-Cut-off Height (*cm*) • Difference of Height and Current-Age-Army-Cut-off Height (*cm*) • Current-Age-Median Height (*cm*) • Difference of Height and Current-Age-Median Height (*cm*) • Target (Adult-Mid-Parental) Height (*cm*) • Percentile-of-Mid-Parental-Height • Current-Age-Mid-Parental Height (*cm*) • Difference of Measured Height and Current-Age-Mid-Parental Height (*cm*) • Estimated-Adult Height (*cm*) • Estimated-Adult Height (*ft-in*) • Refined Status (pertaining-to-height) • Depictive Status (pertaining-to-height)

Mass (Weight) Data

Net Mass (*kg*) • Net Weight (*lb-oz*) • CDC Percentile-of-Net-Mass • Modified-Scaled Percentile-of-Net-Mass • Percentile-of-Reference-*BMI*-based-Optimal-Mass • Reference-*BMI*-based-Optimal Mass (*kg*) • Difference of Mass and Reference-*BMI*-based-Optimal Mass (*kg*) • Height-Percentile-based-Optimal Mass (*kg*) • Difference of Mass and Height-Percentile-based-Optimal Mass (*kg*) • Estimated-Adult Mass (*kg*) • Estimated-Adult Weight (*lb-oz*) • Refined Status (pertaining-to-mass) • Depictive Status (pertaining-to-mass)

Combined Data (Height and Mass)

Away-from-Normality Index • Polar Angle (*degree*) • Enhanced-Nutritional Status • Estimated-Adult *BMI* (kg/m^2) • Estimated-Adult-Specific *BMI* • Build

Fig. 3*a*. Sections of Growth-and-Obesity Scalar-/Vector-Roadmap 5.0 of child (profile portion)

Header

Added in Actual Report: Name • SGPP Identification Number (actual) • Blood Group • Cell Number • e-mail Address • Postal Address

Sample Report: Father/Mother • SGPP Identification Number (camouflaged to protect identity) • Date of Birth (*year-month-day*) • Gender-Specific-Adult-Army-Cut-off Height (*cm*) — corresponding CDC percentile in parentheses • Gender-Specific-Adult-Median Height (*cm*) — corresponding CDC percentile in parentheses

Vital Statistics

Added in Actual Report: Dress Code • Behavior Code

Sample Report: Date of Checkup (*year-month-day*) • Time of Checkup (*a. m./p. m.*) • Age (*year-month-day*) • Age (*decimal year*)

Height Data

Height (*cm*) • Height (*ft-in*) • CDC Percentile-of-Height • Modified-Scaled Percentile-of-Height • Current-Age-Army-Cut-off Height (*cm*) • Difference of Height and Current-Age-Army-Cut-off Height (*cm*) • Current-Age-Median Height (*cm*) • Difference of Height and Current-Age-Median Height (*cm*) • Target (Adult-Mid-Parental) Height (*cm*) • Percentile-of-Mid-Parental-Height • Current-Age-Mid-Parental Height (*cm*) • Difference of Measured Height and Current-Age-Mid-Parental Height (*cm*) • Estimated-Adult Height (*cm*) • Estimated-Adult Height (*ft-in*) • Refined Status (pertaining-to-height) • Depictive Status (pertaining-to-height)

Mass (Weight) Data

Net Mass (*kg*) • Net Weight (*lb-oz*) • CDC Percentile-of-Net-Mass • Modified-Scaled Percentile-of-Net-Mass • Percentile-of-Reference-*BMI*-based-Optimal-Mass • Corrected-Reference-*BMI*-based-Optimal Mass (*kg*) • Difference of Mass and Corrected-Reference-*BMI*-based-Optimal Mass (*kg*) • Corrected-Height-Percentile-based-Optimal Mass (*kg*) • Difference of Mass and Corrected-Height-Percentile-based-Optimal Mass (*kg*) • Estimated-Adult Mass (*kg*) • Estimated-Adult Weight (*lb-oz*) • Refined Status (pertaining-to-mass) • Depictive Status (pertaining-to-mass)

Combined Data (Height and Mass)

Away-from-Normality Index • Polar Angle (*degree*) • Enhanced-Nutritional Status • Estimated-Adult *BMI* (kg/m^2) • Estimated-Adult-Specific *BMI* • Build

Fig. 3*b*. Sections of Growth-and-Obesity Scalar-/Vector-Roadmap 5.0 of parents (profile portion)

the case is again worked out below using Growth-and-Obesity Vector-Roadmap 5.0. A summary of equations used to generate Growth-and-Obesity Vector-Roadmaps 5.0 is available in Figure 4. Growth-and-Obesity Vector-Roadmap 5.0 of twin boy, Z. H. is presented in Tables 4*a-c* as well as twin girl, T. H. in Tables 5*a-c*. To understand puberty rating, given in Roadmaps 5.0 of Z. H. and T. H., the reader is referred to papers published in 2017 and 2021 (Kamal *et al.*, 2017*b* — Table 4; Kamal *et al.*, 2021*a* — Table 3). Table 6 lists instantaneous as well as true wasting/obesity and stunting/tallness for each of the twins.

On examination of Table 4*a*, one notes that Z. H. exhibits **pseudo-gain of height** as well as **pseudo-gain of mass** between 1st and 2nd simulated checkups (height pick-up from **96.00 *cm*** to **98.10 *cm***, CDC percentile-of-height dropping from **78.47^{P}** to **63.55^{P}** as well as mass put-on from **12.00 *kg*** to **12.70 *kg***, CDC percentile-of-mass dropping from **8.74^{P}** to **8.55^{P}**). The phenomenon of pseudo-gain of height (mass) was put forward in Kamal *et al.* (2014*b*). Pseudo-gain of height is present when a drop in CDC percentile-of-height accompanies height gain for two consecutive checkups, with a similar definition for pseudo-gain of mass. Rate of change of fractional statuses of Z. H., $\frac{d(STATUS_{Fr}(h))}{d(STATUS_{Fr}(\mu))}$, between 1st and 2nd

HEIGHT GAIN

Percentile of height approaching asymptotically at the age of 10 *years* to 2nd-simulated-checkup-reference percentile

$$P_{CDC}(h,A) = P_{ref}(A_0); \text{ if } P_{CDC}(h,A_0) = P_{ref}(A_0)$$

$$P_{CDC}(h,A) = P_{ref}(A_0) - \left(P_{ref}(A_0) - P_{CDC}(h,A_0)\right)\left(\frac{A-10}{A_0-10}\right)^2, \text{ otherwise}$$

Z. H. $P_{CDC}(h,A) = 63.5528026394401$

T. H. $P_{CDC}(h,A) = 47.4982793240524$

MASS MANAGEMENT

Percentile of mass approaching asymptotically at the age of 10 *years* to 2nd-simulated-checkup-reference percentile

$$P_{CDC}(\mu,A) = P_{ref}(A_0); \text{ if } P_{CDC}(\mu,A_0) = P_{ref}(A_0)$$

$$P_{CDC}(\mu,A) = P_{ref}(A_0) - \left(P_{ref}(A_0) - P_{CDC}(\mu,A_0)\right)\left(\frac{A-10}{A_0-10}\right)^2, \text{ otherwise}$$

Z. H. $P_{CDC}(\mu,A) = 63.5528026394401 - 1.19823909811048\ (A-10)^2$

T. H. $P_{CDC}(\mu,A) = 47.4982793240524 + 0.65365798678462\ (A-10)^2$

Percentile of mass approaching asymptotically at the age of 10 *years* to percentile of 2nd-simulated-checkup-reference-*BMI*-based-optimal mass

$$P_{CDC}(\mu,A) = P_{ref\text{-}BMI}(A_0); \text{ if } P_{CDC}(\mu,A_0) = P_{ref\text{-}BMI}(A_0)$$

$$P_{CDC}(\mu,A) = P_{ref\text{-}BMI}(A_0) - \left(P_{ref\text{-}BMI}(A_0) - P_{CDC}(\mu,A_0)\right)\left(\frac{A-10}{A_0-10}\right)^2, \text{ otherwise}$$

Z. H. $P_{CDC}(\mu,A) = 69.217396274093 - 1.321636568302079\ (A-10)^2$

T. H. $P_{CDC}(\mu,A) = 62.90241784775025 + 0.31809433528507\ (A-10)^2$

Fig. 4. Equations used to generate monthly recommendations in the context of Growth-and-Obesity Vector-Roadmap 5.0

simulated checkups comes out to be –0.6551. Navigational and guidance simulated trajectories of percentiles of height and mass of Z. H. are shown in Figure 5. Compare these results with the results obtained using Growth-and-Obesity Vector-Roadmap 3.0 (Kamal *et al.*, 2020 — Table 10*a*).

On examination of Table 5*a*, one notes that T. H. exhibits **pseudo-gain of height** as well as **pseudo-gain of mass** between 1st and 2nd simulated checkups (height pick-up from **94.10 *cm*** to **95.20 *cm***, CDC percentile-of-height dropping from **71.85P** to **47.50P** as well as mass put-on from **15.10 *kg*** to **15.80 *kg***, CDC percentile-of-mass dropping from **82.28P** to **77.50P**). Rate of change of fractional statuses of T. H., $\frac{d\left(STATUS_{Fr}(h)\right)}{d\left(STATUS_{Fr}(\mu)\right)}$, between 1st and 2nd simulated checkups comes out to be –0.9990.

Navigational and guidance simulated trajectories of percentiles of height and mass of T. H. are shown in Figure 6. Compare these results with the results obtained using Growth-and-Obesity Vector-Roadmap 3.0 (Kamal *et al.*, 2020 — Table 11*a*). Formulae for height-gain-target-achievement index and mass-management-target-achievement index are given elsewhere (Kamal *et al.*, 2021*b* — Figure 7) based on refined

Table 4*a*. Growth-and-Obesity Vector-Roadmap 5.0 of Z. H. (SGPP-KHI-20080104-01/simulated)

Gender: Male ♀ • *Date of Birth* (*year-month-day*): 2005-11-15
Adult-Army-Cut-off Height: ♀ 162.56 *cm* (2.72^{P}) • *Adult-Median Height*: ♀ 175.43 *cm* (43.21^{P})

Simulated Checkup	*1st*	*2nd*
Photograph		
Scanned Signatures	*ZH*	*ZH*
Class	ECE-I	ECE-I
Date of Checkup (*year-month-day*)	2008-08-10	2009-02-05
Time of checkup (*a. m.*)	09: 00	09: 45
Age (*year-month-day*)	02-08-25	03-02-20
Age (*decimal year*)	2.74	3.22
Puberty Rating	Tanner 1	Tanner 1
Height (*cm*) ⇐	**96.00**	**98.10**
Height (*ft-in*)	3 *ft* 1.80 *in*	3 *ft* 2.62 *in*
CDC Percentile-of-Height ⇔	**78.47^{P}**	**63.55^{P}**
Modified-Scaled Percentile-of-Height	86.16^{P}	71.94^{P}
Current-Age-Army-Cut-off Height (*cm*) ⇐	85.62	89.14
Difference of Height and Current-Age-Army-Cut-off Height (*cm*)	+10.38	+8.96
Current-Age-Median Height (*cm*) ⇐	92.17	95.93
Difference of Height and Current-Age-Median Height (*cm*)	+3.83	+2.17
Target (Adult-Mid-Parental) Height (*cm*)	170.10	170.71
Percentile-of-Mid-Parental-Height	18.74^{P}	20.83^{P}
Current-Age-Mid-Parental Height (*cm*) ⇐	89.41	93.39
Difference of Height and Current-Age-Mid-Parental Height (*cm*)	+6.59	+4.71
Estimated-Adult Height (*cm*)	182.54	179.35
Estimated-Adult Height (*ft–in*)	**5 *ft* 11.87 *in***	**5 *ft* 10.61 *in***
Refined Status (pertaining-to-height)	+4.16%	+2.26%
Depictive Status (pertaining-to-height)	**1st-Degree Tall**	**1st-Degree Tall**
Net Mass (*kg*) ⇒	**12.00**	**12.70**
Net Weight (*lb-oz*)	26 *lb* 7.36 *oz*	28 *lb* 0.06 *oz*
CDC Percentile-of-Mass ⇔	**8.74^{P}**	**8.55^{P}**
Modified-Scaled Percentile-of-Mass	25.93^{P}	25.51^{P}
Percentile-of-Reference-*BMI*-based-Optimal-Mass ⇔	76.23^{P}	69.22^{P}
Reference-*BMI*-based-Optimal Mass (*kg*) ⇒	15.07	15.66
Difference of Mass and Reference-*BMI*-based-Optimal Mass (*kg*)	–3.07	–2.96
Height-Percentile-based-Optimal Mass (*kg*) ⇒	15.24	15.39
Difference of Mass and Height-Percentile-based-Optimal Mass (*kg*)	–3.24	–2.69
Estimated-Adult Mass (*kg*)	57.72	57.61
Estimated-Adult Weight (*lb–oz*)	127 *lb* 4.24 *oz*	127 *lb* 0.55 *oz*
Refined Status (pertaining-to-mass)	–20.38%	–17.49%
Depictive Status (pertaining-to-mass)	**3rd-Degree Wasted**	**2nd-Degree Wasted**
Away-from-Normality Index	0.2080	0.1763
Polar Angle (*degrees*)	168.48^{o}	172.63^{o}
Enhanced-Nutritional Status	**W-EC I**	**W-EC I**
Estimated-Adult *BMI* (kg/m^2)	17.32	17.91
Estimated-Adult-Specific *BMI*	0.722	0.746
Build	**Medium**	**Medium**

Table 4*b***.** Height-gain-target-achievement index, h_C, and mass-management-target-achievement index, μ_C, of Z. H. at his 2nd simulated checkup

February 5, 2009	*Height*		*Mass* (*Weight*)	
	cm	*ft-in*	*kg*	*lb-oz*
Values at 2nd Simulated Checkup	**98.10**	**3 *ft* 2.62 *in***	**12.70**	**28 *lb* 0.06 *oz***
Recommended by Roadmap 5.0	99.91	3 *ft* 3.33 *in*	13.26-13.28	29 *lb* 3.80 *oz* - 29 *lb* 4.39 *oz*
Target-Achievement Index	98.19 %		95.78 % ↓	
Qualitative	h_C under-achieved		μ_C under-achieved[$]	

[$]Lesser mass outside the normal range

and complex statuses (Kamal *et al.*, 2021*b* — Figures 5*a*, *b*).

Lifestyle adjustment, diet and exercise plans for children and their parents are adapted from resources available elsewhere (Kamal *et al.*, 2021*a*, Additional File 4; Kamal and Khan, 2020 — Table 4**:** children, Table 5**:** parents) and are given in Table 7 (children) and Table 11 (parents). Growth-and-Obesity Scalar-Roadmap 5.0 of father is given in Tables 8*a*-*c* as well as that of mother in Tables 9*a*-*c*, whereas Table 10 lists instantaneous as well as true wasting/obesity and stunting/tallness for each of the parents.

Rate of change of fractional statuses of father, $\frac{d(STATUS_{Fr}(h))}{d(STATUS_{Fr}(\mu))}$, between 1st and 2nd simulated check-ups comes out to be zero. Compare these results with the results obtained using Growth-and-Obesity Vector-Roadmap 3.0 (Kamal *et al.*, 2020 — Table 12*a*).

On examination of Table 9*a*, one notes that mother exhibits **pseudo-gain of mass** between 1st and 2nd simulated checkups (mass put-on from **52.50 *kg*** to **53.10 *kg***, CDC percentile-of-mass dropping from **46.56[P]** to **45.67[P]**). Rate of change of fractional statuses of mother, $\frac{d(STATUS_{Fr}(h))}{d(STATUS_{Fr}(\mu))}$, between 1st and 2nd simulated checkups comes out to be zero. Compare these results with the results obtained using Growth-and-Obesity Vector-Roadmap 3.0 (Kamal *et al.*, 2020 — Table 13*a*).

Table 12 gives time slots, valid for the city of Karachi, Pakistan, for full body sun-exposure of growing parents as well as their son and daughter during the 6-*month* period following their 2nd simulated checkups to obtain the required doses of vitamin D.

CONCLUSION

In this paper the author has proposed the eleventh-generation solution of childhood obesity-and-malnutrition, to be used for sons and daughters of still-growing parents as Growth-and-Obesity Scalar- and Vector-Roadmaps 5.0. Simulated data of twin children and their parents (who have not reached their final heights) have been utilized to illustrate the method. This paper is a continuation of earlier work dealing with early-childhood marriages and their implications on the personalities of the young couples, resulting in

Table 4*c***.** Month-wise height-gain targets as well as month-wise mass-management and weight-management target-ranges for Z. H. based on his 2nd simulated checkup

Target Date	*Height-Gain Target*		*Mass-Management and Weight-Management Target-Ranges*	
	cm	*ft-in*	*kg*	*lb-oz*
February 5, 2009 (reference)	**98.10**	**3 *ft* 2.62 *in***	**12.70**	**28 *lb* 0.06 *oz***
March 5, 2009 (1st month)	98.68	3 *ft* 2.85 *in*	13.02-13.03	28 *lb* 11.24 *oz* - 28 *lb* 11.78 *oz*
April 5, 2009 (2nd month)	99.33	3 *ft* 3.10 *in*	13.22-13.25	29 *lb* 12.56 *oz* - 29 *lb* 13.38 *oz*
May 5, 2009 (3rd month)	99.95	3 *ft* 3.35 *in*	13.42-13.45	29 *lb* 19.66 *oz* - 29 *lb* 10.77 *oz*
June 5, 2009 (4th month)	100.57	3 *ft* 3.60 *in*	13.64-13.67	30 *lb* 1.22 *oz* - 30 *lb* 2.62 *oz*
July 5, 2009 (5th month)	101.16	3 *ft* 3.83 *in*	13.85-13.90	30 *lb* 18.68 *oz* - 30 *lb* 10.37 *oz*
August 5, 2009 (6th month)	101.77	3 *ft* 4.07 *in*	14.07-14.13	31 *lb* 0.43 *oz* - 31 *lb* 12.43 *oz*

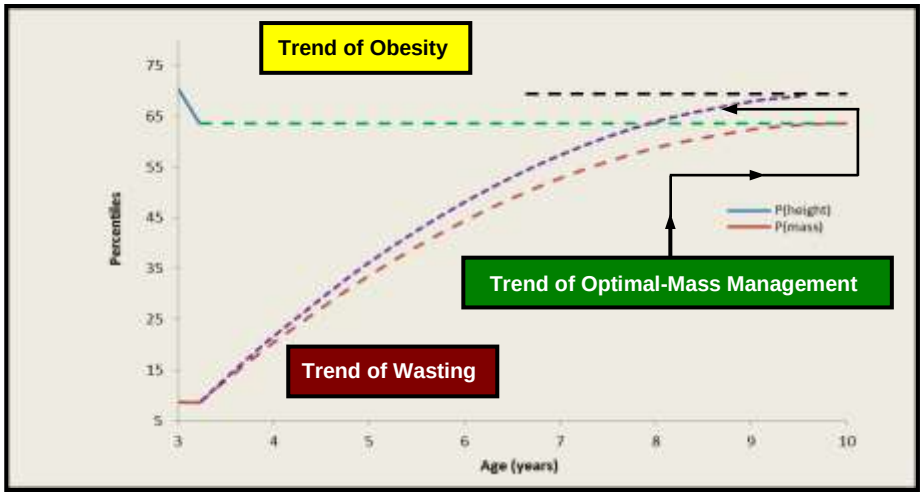


Fig. 5. CDC percentile-of-height and percentile-of-mass of Z. H. — actual and targeted values (navigational and guidance simulated trajectories)

disruption in their education, lack of knowledge to manage young children and serious physical and mental health issues for the underage mother. There are attempts to discourage underage marriages in this part of the world through education, counseling and even legislation, but the problem still persists.

With a nutritious and a healthy diet, abundant opportunities to involve in sport outdoors and a lifestyle free from day-to-day tensions for children and their parents, mindset of the younger generation changed from disappointment, frustration and fear to determination, courage and positive thinking, the qualities of leader-integrators of the community, the author is confident that the future generation should be able to concentrate on getting educated combined with skills needed to deal with the challenges of the third millennium and make their respective countries in the south-east Asia excel in STEM (Science, Technology, Engineering and Mathematics) and make them stronger and powerful by taking up opportunities offered by the complex economic interdependence of today to become financially sustainable and improve their National Happiness Index (a concept propagated in Nepal) and Human Development Index (a concept introduced by the Pakistani economist, Mahboob-ul-Haq in 1990) — a dream nurtured by founders of Pakistan in 1940s.

KEY POINTS

- Growth-and-Obesity Roadmaps 4.5 were generalized to Growth-and-Obesity Roadmaps 5.0 to study obesity/malnutrition in children of still-growing parents by replacing estimated-adult height of each parent in place of measured height to compute target height (Roadmaps 5.0 different from Roadmaps 3.0 in the sense that reference height is now the maximum of 4 heights**:** measured height, median height, current-age-army-cut-off height, current-age-mid-parental height — last 3 gender-specific)
- Simulated data of twin children (boy and girl) and their parents are employed to generate sample Scalar- and Vector-Roadmaps 5.0.
- Graphical representations of CDC percentile-of-height and CDC percentile-of-mass for the twin boy and the twin girl are given, which illustrate regions showing trends of obesity, wasting and optimal-mass management.
- To demonstrate applicability of Growth-and-Obesity Scalar-Roadmap 5.0 for children of still-growing parents, calculations of the youngest mother in recorded history are given to demonstrate that when the mother is still under-19, her son would be more than 9.5 *years* old.
- Implications of different types of marriages (underage, late, forced, love, arranged) are briefly summarized.

CONFLICT OF INTEREST

The author declares no conflict of interest. This work contains no libelous or unlawful statements and does not infringe or violate the publicity or the privacy rights of any third party.

Table 5*a*. Growth-and-Obesity Vector-Roadmap 5.0 of T. H. (SGPP-KHI-20080104-01/simulated)

Gender: Female ♀ • *Date of Birth* (*year-month-day*): 2005-11-15
Adult-Army-Cut-off Height: ♀ 157.48 *cm* (19.36^{P}) • *Adult-Median Height*: ♀ 160.69 *cm* (34.85^{P})

Simulated Checkup	*1st*	*2nd*
Photograph		
Scanned Signatures	*TH*	*TH*
Class	ECE-I	ECE-I
Date of Checkup (*year-month-day*)	2008-08-10	2009-02-05
Time of checkup (*a. m.*)	09: 00	09: 45
Age (*year-month-day*)	02-08-25	03-02-20
Age (*decimal year*)	2.74	3.22
Puberty Rating	Tanner 1	Tanner 1
Height (*cm*) ⇐	**94.10**	**95.20**
Height (*ft-in*)	3 *ft* 1.05 *in*	3 *ft* 1.48 *in*
CDC Percentile-of-Height ⇔	**71.85^{P}**	**47.50^{P}**
Modified-Scaled Percentile-of-Height	85.34^{P}	64.13^{P}
Current-Age-Army-Cut-off Height (*cm*) ⇐	89.51	91.87
Difference of Height and Current-Age-Army-Cut-off Height (*cm*)	+4.59	+3.33
Current-Age-Median Height (*cm*) ⇐	90.26	93.83
Difference of Height and Current-Age-Median Height (*cm*)	+2.77	+0.14
Target (Adult-Mid-Parental) Height (*cm*)	157.10	157.71
Percentile-of-Mid-Parental-Height	17.90^{P}	20.21^{P}
Current-Age-Mid-Parental Height (*cm*) ⇐	89.29	92.00
Difference of Height and Current-Age-Mid-Parental Height (*cm*)	+4.81	+3.20
Estimated-Adult Height (*cm*)	167.17	160.93
Estimated-Adult Height (*ft–in*)	**5 *ft* 5.82 *in***	**5 *ft* 3.36 *in***
Refined Status (pertaining-to-height)	+4.25%	+1.46%
Depictive Status (pertaining-to-height)	**1st-Degree Tall**	**1st-Degree Tall**
Net Mass (*kg*) ⇒	**15.10**	**15.80**
Net Weight (*lb-oz*)	33 *lb* 4.73 *oz*	34 *lb* 13.42 *oz*
CDC Percentile-of-Mass ⇔	**82.28^{P}**	**77.50^{P}**
Modified-Scaled Percentile-of-Mass	95.96^{P}	94.35^{P}
Percentile-of-Reference-*BMI*-based-Optimal-Mass ⇔	76.92^{P}	62.90^{P}
Reference-*BMI*-based-Optimal Mass (*kg*) ⇒	14.67	14.95
Difference of Mass and Reference-*BMI*-based-Optimal Mass (*kg*)	+0.43	+0.85
Height-Percentile-based-Optimal Mass (*kg*) ⇒	14.39	13.69
Difference of Mass and Height-Percentile-based-Optimal Mass (*kg*)	+0.71	+2.11
Estimated-Adult Mass (*kg*)	70.46	67.44
Estimated-Adult Weight (*lb–oz*)	155 *lb* 5.81 *oz*	148 *lb* 11.23 *oz*
Refined Status (pertaining-to-mass)	+2.90%	+5.70%
Depictive Status (pertaining-to-mass)	**1st-Degree Obese**	**1st-Degree Obese**
Away-from-Normality Index	0.0515	0.0588
Polar Angle (*degrees*)	55.75^{o}	14.34^{o}
Enhanced Nutritional Status	**T-ON**	**O-ON**
Estimated-Adult *BMI* (kg/m^2)	25.21	26.04
Estimated-Adult-Specific *BMI*	1.051	1.085
Build	**Big**	**Big**

Table 5*b*. Height-gain-target-achievement index, h_C, and mass-management-target-achievement index, μ_C, of T. H. at her 2nd simulated checkup

February 5, 2009	*Height*		*Mass* (*Weight*)	
	cm	*ft-in*	*kg*	*lb-oz*
Values at 2nd Simulated Checkup	**95.20**	**3 *ft* 1.48 *in***	**15.80**	**34 *lb* 13.42 *oz***
Recommended by Roadmap 5.0	97.87	3 *ft* 2.53 *in*	16.11-16.17	35 *lb* 8.49 *oz* - 35 *lb* 10.63 *oz*
Target-Achievement Index	98.19 %		95.78 % ↓	
Qualitative	h_C under-achieved		μ_C under-achieved$^{\beta}$	

$^{\beta}$Lesser mass outside the normal range

Table 5*c*. Month-wise height-gain targets as well as month-wise mass-management and weight-management target-ranges for T. H. based on her 2nd simulated checkup

Target Date	*Height-Gain Target*		*Mass-Management and Weight-Management Target-Ranges*	
	cm	*ft-in*	*kg*	*lb-oz*
February 5, 2009 (reference)	**95.20**	**3 *ft* 1.48 *in***	**15.80**	**34 *lb* 13.42 *oz***
March 5, 2009 (1st month)	95.73	3 *ft* 1.69 *in*	15.84-15.91	34 *lb* 14.87 *oz* - 35 *lb* 1.28 *oz*
April 5, 2009 (2nd month)	96.31	3 *ft* 1.92 *in*	15.96-16.07	35 *lb* 3.08 *oz* - 35 *lb* 6.81 *oz*
May 5, 2009 (3rd month)	96.87	3 *ft* 2.14 *in*	16.09-16.22	35 *lb* 7.58 *oz* - 35 *lb* 12.13 *oz*
June 5, 2009 (4th month)	97.45	3 *ft* 2.37 *in*	16.24-16.38	35 *lb* 13.01 *oz* - 36 *lb* 1.84 *oz*
July 5, 2009 (5th month)	98.00	3 *ft* 2.58 *in*	16.39-16.54	36 *lb* 2.37 *oz* - 36 *lb* 7.46 *oz*
August 5, 2009 (6th month)	101.77	3 *ft* 4.07 *in*	16.55-16.70	36 *lb* 7.87 *oz* - 36 *lb* 13.23 *oz*

DEDICATION

This paper is dedicated to the loving memory of **Professor Dr. Khursheed Athar Siddiqui** (Friday, January 2, 1948 AD - Friday, October 7, 2022 AD, corresponding to Rabi-ul-Awwal 10, 1444 AH). A well-known physicist, educator and researcher, he received all of his education up to MSc from Karachi — Secondary School Certificate (Matriculation) in 1964, High Secondary Certificate (Intermediate) in 1966, BSc in 1968 (DJ

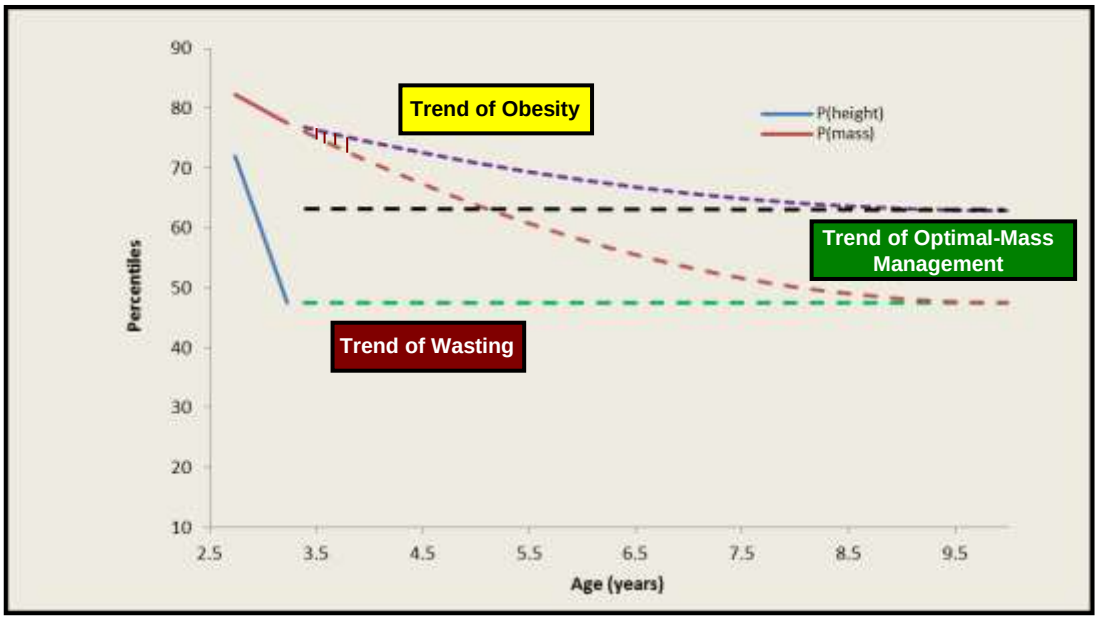
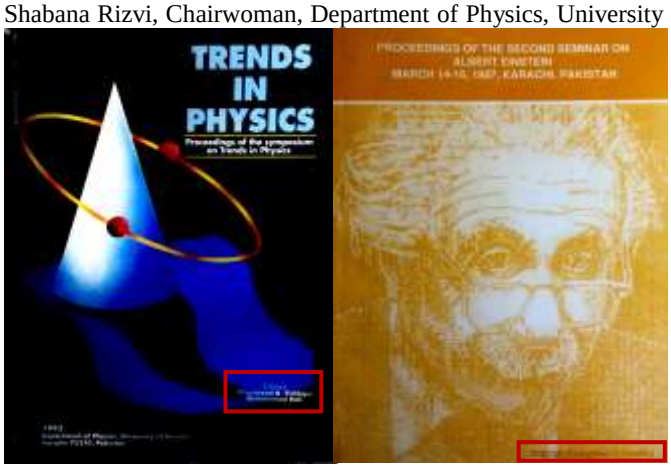


Fig. 6. CDC percentile-of-height and percentile-of-mass of T. H. — actual and targeted values (navigational and guidance simulated trajectories)

Table 6. Instantaneous and true obesity/wasting as well as instantaneous and true tallness/stunting (Kamal *et al.*, 2021*b* — Tables 7-10) during each simulated checkup of Z. H. and T. H.

Simulated Checkup	*Z. H.*		*T. H.*	
	1st	*2nd*	*1st*	*2nd*
Instantaneous Tallness	Present	Present	Present	Present
True Tallness	Present	Present	Present	Present
Instantaneous Stunting	Absent	Absent	Absent	Absent
True Stunting	Absent	Absent	Absent	Absent
Instantaneous Obesity	Absent	Absent	Present	Present
True Obesity	Absent	Absent	Absent	Absent
Instantaneous Wasting	Present	Present	Absent	Absent
True Wasting	Present	Present	Absent	Absent
True Over-Nutrition	Absent	Absent	Absent	Absent
True Energy-Channelization I	Present	Present	Absent	Absent
True Under-Nutrition	Absent	Absent	Absent	Absent
Acute Malnutrition	Absent	Absent	Absent	Absent
True Energy-Channelization II	Absent	Absent	Absent	Absent

Science College), and MSc, Physics, in 1971 (University of Karachi). Then he proceeded to England to obtain his PhD in 1978 from University of Nottingham. The title of his doctoral dissertation was "Interaction with Cr3+ Pairs". He joined Department of Physics, University of Karachi as lecturer in 1979 and took early retirement in September 2004. He also served Departments of Physics in University of Baluchistan, Quetta, Pakistan and King Abdul Aziz University, Jeddah, Saudi Arabia as well as Visiting Faculty in Department of Chemistry, University of North Carolina, Chapel Hill on a Fulbright fellowship. His MPhil student, Professor Dr. Mohummed Shahid Qureshi served as Director of Institute of Space and Planetary Astrophysics, University of Karachi. His PhD student, Professor Dr. Nasiruddin Khan worked as Pro-Vice Chancellor of University of Karachi. Other students, who reached top positions, are Professor Dr. Jameel-un-Nabi, DSc (United States), Vice Chancellor, University of Wah and Professor Dr. Shabana Rizvi, Chairwoman, Department of Physics, University of Karachi. He



organized many conferences and seminars and edited their proceedings, snapshots of the title pages of a couple of them are inserted on the left. The author had a very special bonding with Professor Siddiqui. Upon returning from the United States, the author was offered to share office by his colleague. The late professor was instrumental in helping the author select his PhD topic and provided literature to start the work. In addition, the author and his colleague traveled together to many scientific conferences. The legendary professor had the highest number of publications and conference presentations in common with the author in neurophysics, modeling of the heart function, mathematical and theoretical physics as well as physics teaching and curriculum development. These are listed separately in Figure 7 (Ahmed *et al.*, 1997; Kamal and Siddiqui, 1986; 1989; 1993; 1997*a*; *b*; Kamal *et al.*, 1989*a*; *b*; 1992; 1993; 2000; 2009; Siddiqui and Kamal, 1986; 1987; 1992; Siddiqui *et al.*, 1990; 1993), as they are not related to the main theme of this work. It is to be noted that, probably, the first proposal to replace BSc, BSc (Honors) and MSc with BS and MS in the Pakistani curriculum was given in Kamal and Siddiqui (1989), which was adopted by Higher Education Commission, Government of Pakistan in 2004. The author had the unique honor to prepare the first model curriculum and scheme of studies of BS, MS and PhD for

Journal Papers

Ahmed, S. N., **S. A. Kamal**, **K. A. Siddiqui**, S. A. Husain and M. Naeem (1997). EEG in weightlessness**:** a theoretical estimate. *Karachi University Journal of Science*, 25 (1)**:** 19-24, full text**:** https**://**www.ngds-ku.org/Papers/J20.pdf

Kamal, S. A. and **K. A. Siddiqui** (1989). Basic requirements to train a physicist. *Physics Education* (*India*), 6 (1)**:** 53-61, full text**:** https**://**www.ngds-ku.org/Papers/J09.pdf

Kamal, S. A. and **K. A. Siddiqui** (1997*a*). The covariant-generalized-coupling model of global-electrocortical activity. *Karachi University Journal of Science*, 25 (1)**:** 29-39, full text**:** https**://**www.ngds-ku.org/Papers/J19.pdf

Kamal, S. A., **K. A. Siddiqui** and Naseeruddin (2000). The sixth paradigm of physics. *Karachi University Journal of Science*, 28 (2)**:** 11-16, full text**:** https**://**www.ngds-ku.org/Papers/J24.pdf

Kamal, S. A., **K. A. Siddiqui** and Naseeruddin (2009). Concept building in the undergraduate mathematics and physics curricula. *Karachi University Journal of Science*, 37 (1&2)**:** 1-6, full text**:** https**://**www.ngds-ku.org/Papers/J28.pdf

Kamal, S. A., **K. A. Siddiqui** and S. A. Husain (1989*a*). Spacetime representation of global-electrocortical activity. *Biological Cybernetics*, 60 (4)**:** 307-309, full text**:** https**://**www.ngds-ku.org/Papers/J08.pdf

Kamal, S. A., **K. A. Siddiqui** and S. A. Husain (1992). Effects of weak magnetic fields on global-electrocortical activity. *Karachi University Journal of Science*, 20 (1&2)**:** 31-35, full text**:** https**://**www.ngds-ku.org/Papers/J12.pdf

Kamal, S. A., **K. A. Siddiqui**, S. A. Husain and N. U. Khan (1993). Effects of weak electromagnetic fields on global-electrocortical activity. *Journal of Biological Physics*, 18 (4)**:** 261-269, full text**:** https**://**www.ngds-ku.org/Papers/J13.pdf

Siddiqui, K. A., **S. A. Kamal**, S. A. Husain and N. U. Khan (1993). Group structure of a covariant model of global-electrocortical activity. *Karachi University Journal of Science*, 21 (1&2)**:** 35-38, full text**:** https**://**www.ngds-ku.org/Papers/J14.pdf

Conference Presentations

Kamal, S. A. and **K. A. Siddiqui** (1986, December 27, 28). How to develop creative thinking and critical analysis? *Proceedings of the Second Workshop on Teaching of Physics*, edited by A. F. Hasnain, Karachi, Pakistan, pp. 51-56, full text**:** https**://**www.ngds-ku.org/Papers/C24.pdf

Kamal, S. A. and **K. A. Siddiqui** (1993). Modeling of heart function. *Proceedings of the Symposium on Trends in Physics*, September 26, 27, 1992, edited by K. A. Siddiqui and M. Rafi, Department of Physics, University of Karachi, Karachi, Pakistan, full text**:** https**://**www.ngds-ku.org/Papers/C39.pdf

Kamal, S. A. and **K. A. Siddiqui** (1997*b*, March 30-April 3). The sixth paradigm of physics**:** mathematical formulation. *The Fourth Pakistan Institute of Physics International Conference* (*PIPC 1997*), Government College, Lahore, Pakistan, p. 11, abstract#2**:** https**://**www.ngds-ku.org/Presentations/Paradigm.pdf

Kamal, S. A., M. Akram, **K. A. Siddiqui** and N. U. Khan (1989*b*, August 14-18). Moiré, raster and EEG studies of epileptics during the washable memory period. *The Seventh International Conference on Biomagnetism*, New York University, New York, United States, p. 3, paper#AS-34, full text**:** https**://**www.ngds-ku.org/Papers/C30.pdf

Siddiqui, K. A. and **S. A. Kamal** (1986, December 27, 28). Physics makes the deaf and the dumb equations of mathematics to speak. *Proceedings of the Second Workshop on Teaching of Physics*, edited by A. F. Hasnain, Karachi, Pakistan, pp. 40-49, full text**:** https**://**www.ngds-ku.org/Papers/C25.pdf

Siddiqui, K. A. and **S. A. Kamal** (1987, October 14-17). A survey of school and pre-university physics education in Pakistan. *Physics Education in Asia* (*a collection of selected papers*), *Regional Physics Education Symposium and Aspen general Conference*, edited by S. B. Aidid, M. Z. Ismail, A. K. Koh and M. M. Singh, Kuala Lumpur, Malaysia, pp. 81-89, full text**:** https**://**www.ngds-ku.org/Papers/C28.pdf

Siddiqui, K. A. and **S. A. Kamal** (1992, June 25-July 9). Electrodynamics of the brain. *The Seventeenth International Nathiagali Summer College on Physics and Contemporary Needs*, p. 28, abstract#24**:** https**://**www.ngds-ku.org/Presentations/Electrodynamics.pdf

Siddiqui, K. A., **S. A. Kamal** and N. U. Khan (1990). Neurophysics**:** a beginner's viewpoint. *Proceedings of the Second National Symposium on Frontiers in Physics*, December 26-31, 1988, edited by G. Murtaza and M. A. Baig, the Quaid-é-Azam University, Islamabad, Pakistan, pp. 285-305, full text**:** https**://**www.ngds-ku.org/Papers/C35.pdf

Fig. 7**.** Collaborative work of author (9 journal papers and 8 conference presentations) with his beloved colleague

Mathematics and its revision as Convener of National Curriculum Revision Committee (Mathematics) during 2004-2012 as well as prepare curriculum of GAT (Mathematics) for National Testing Service Pakistan. University

Table 7. Lifestyle adjustment, diet and exercise plans for Z. H. and T. H.

	Height Management	*Mass* (*Weight*) *Management*
Lifestyle Adjustment	2-3-*hour* family time on a daily basis, with cell phones and tablets kept away (conversation — parents should educate children about environmental-resource preservation**:** trees and forests, water reservoirs, clean-fresh air, plastic pollution; religious tolerance; ethnic diversity; empathy to feeling of others; joy of sharing); family may stroll in the park/relax on benches; recommended daily dose of vitamin D (600 IU) through 10-15-*minute* guarded-graduated sun-exposure (early morning or late afternoon) with Z. H. dressed in briefs only, T. H. in panties only, both stripped-to-waist, barefooted and bareheaded, facing away from sun and eyes protected through UV (ultra-violet)-cut-off glasses or indigenously-made spectacles; T. H.'s hair unbraided, spread out and opened up (allowing them to breathe); same clothing for 1-1.5 *hour* gymnastic exercises, T. H.'s hair tied up in the form of (hair) bun; 2-3-*hour* free play in fresh air (jogging/running/ cycling), unclothed from the waist up (T. H.'s hair as during sun-exposure), wearing gym shorts with briefs/panties, pure cotton socks and sneakers; walking/small-area games/table tennis/badminton/tennis, no clothing above the waist (T. H.'s hair open up), Z. H. in dress shorts with briefs, T. H. in miniskirt with panties; hair and body massage with olive oil before bathing; 8-*hour*, night-time, sound sleep dressed in fire-resistant pajama-shorts only, stripped-to-waist; 3-*minute*, slow-stoke back massage to improve quality and quantity of sleep — before retiring to bed, all hair accessories, jewelry, watch, belt removed (hair as during sun exposure); glass of milk consumed before bedtime; teeth brushed 5 times — upon rising, after breakfast, lunch and dinner each as well as before going to bed; additional brushing after consuming candies/chocolates/ cookies/ juices/milk; maximum 1-*hour* screen time (computer/video games/TV/DVD — computer monitor at eye level, neck and back straight as well as normal to thighs); 2-strap school bags worn on back with each strap on a shoulder (unnecessary books/copies/journals taken out); pure cotton undergarments and socks (disinfectant powder to be applied to dry body parts and wiped feet before putting on underwear/socks to prevent fungus infection), pure leather mocation shoes with foot support — tight undergarments, clothes, shoes and slippers (flip-flops) should not be worn, slippers got wet during ablution should be replaced immediately with dry ones to be put on carefully dried feet wiped between toes (same goes on with clothes drenched in rain, *etc.*); absolutely NO high heels for girls — cause toes to bend inward	
Diet Plans	3 relaxed (wait for food, not let the food wait for you; no eating/drinking while walking or standing; eat when very hungry, abstain when some appetite remains) and balanced meals, should include fresh fruits and green vegetables; 10-12 glasses of water daily; only one 250-*ml* bottle of carbonated drink within a *month* — plastic shoppers should not be used to pack food items, in particular, carbonated drinks/tea/coffee; do not forget to check expiry date for packed food and drink items	
	To gain height, diet plan should include calcium-, protein- and fiber-rich diet (chicken, fish, fresh fruit and milk)	To put on mass (weight), diet plan of Z. H. and T. H. should include milk, potato items (baked/boiled, not fried) and protein-rich diet
Exercise Plans	Exercises for 5 *minutes* each after waking up, at the end of every hour and before going to bed — bending on sides, focusing eyes far away and moving eyeballs, moving fingers and wrists after computer work writing, stretching, touching toes without flexing knees, exercising neck muscles (left, right, up, down), light exercises during TV/DVD watching; guarded-graduated structured exercises, preceded by warm-up and followed by cool-down routines, preferably outdoors (weather permitting) in exercise-friendly clothing (form-fitting, made of absorbent material); table tennis; jogging; cycling	
	To pick up height, child should perform light-stretching exercises (bar hanging, mild-stretching, summersault, cartwheel)	To increase mass (weight), Z. H. and T. H. should perform heavy exercises for shorter duration, consistently

of Karachi honored Professor Siddiqui by making him a member of ASRB (Advanced Studies and Research Board) after his retirement, a distinction normally reserved for a *Professor Emeritus*. His funeral prayers were offered after the Friday prayers in Masjid-é-Ibrahim, University of Karachi and he was buried in the graveyard of University of Karachi. He leaves behind his wife, a son and a daughter and 5 grandchildren. Department of Physics, University of Karachi held a condolence meeting to remember their beloved colleague on Thursday, October 13, 2022 at 11**:** 15 a. m. Dr. Ahmed Shahzad Khan of Chicago, United States wrote an obituary of the

Table 8*a*. Growth-and-Obesity Scalar-Roadmap 5.0 of father (SGPP-KHI-20080104-01/simulated)

Date of Birth (*year-month-day*)**:** 1990-07-04
*Adult-Army-Cut-off Height***:** 162.56 *cm* (2.72^{P}) • *Adult-Median Height***:** 175.43 *cm* (43.21^{P})

Simulated Checkup	*1st*	*2nd*
Date of Checkup (*year-month-day*)	2008-08-10	2009-02-05
Time of checkup (*a. m.*)	09**:** 00	09**:** 45
Age (*year-month-day*)	18-01-06	18-07-01
Age (*decimal year*)	18.10	18.59
Height (*cm*) ⇐	168.20	170.10
Height (*ft-in*)	5 *ft* 6.22 *in*	5 *ft* 6.97 *in*
CDC Percentile-of-Height ⇔	15.64^{P}	20.75^{P}
Modified-Scaled Percentile-of-Height	19.41^{P}	25.51^{P}
Current-Age-Army-Cut-off Height (*cm*) ⇐	161.45	161.90
Difference of Height and Current-Age-Army-Cut-off Height (*cm*)	+6.75	+8.20
Current-Age-Median Height (*cm*) ⇐	174.55	174.89
Difference of Height and Current-Age-Median Height (*cm*)	–6.35	–4.79
Target (Adult-Mid-Parental) Height (*cm*)	167.43^{v}	167.43
Percentile-of-Mid-Parental-Height	9.76^{P}	9.76^{P}
Current-Age-Mid-Parental Height (*cm*) ⇐	166.39	166.81
Difference of Height and Current-Age-Mid-Parental Height (*cm*)	+1.81	+3.29
Estimated-Adult Height (*cm*)	169.19	170.68
Estimated-Adult Height (*ft–in*)	**5 *ft* 6.61 *in***	**5 *ft* 7.20 *in***
Refined Status (pertaining-to-height)	0	0
Depictive Status (pertaining-to-height)	**Normal**	**Normal**
Net Mass (*kg*) ⇒	57.60	59.40
Net Weight (*lb-oz*)	127 *lb* 0.13 *oz*	130 *lb* 15.63 *oz*
CDC Percentile-of-Mass ⇔	15.23^{P}	18.00^{P}
Modified-Scaled Percentile-of-Mass	38.35^{P}	42.83^{P}
Percentile-of-Reference-*BMI*-based-Optimal-Mass ⇔	59.51^{P}	59.51^{P}
Reference-*BMI*-based-Optimal Mass (*kg*) ⇒	70.56	71.56
Difference of Mass and Reference-*BMI*-based-Optimal Mass (*kg*)	–12.96	–12.16
Height-Percentile-based-Optimal Mass (*kg*) ⇒	57.73	60.31
Difference of Mass and Height-Percentile-based-Optimal Mass (*kg*)	–0.13	–0.91
Estimated-Adult Mass (*kg*)	60.23	61.99
Estimated-Adult Weight (*lb–oz*)	132 *lb* 13.00 *oz*	134 *lb* 15.90 *oz*
Refined Status (pertaining-to-mass)	–0.23%	–1.50%
Depictive Status (pertaining-to-mass)	**1st-Degree Wasted**	**1st-Degree Wasted**
Away-from-Normality Index	0.0023	0.0150
Polar Angle (*degree*)	180.00^{o}	180.00^{o}
Enhanced-Nutritional Status	**Wasting**	**Wasting**
Estimated-Adult *BMI* (kg/m^2)	21.04	21.01
Estimated-Adult-Specific *BMI*	0.877	0.875
Build	**Medium**	**Medium**

[v] Paternal grandmother of T. H. and Z. H. is above the age of 19 *years* (measured height = estimated-adult height = 150.27 *cm*); paternal grandfather is above the age of 21 *years* (measured height = estimated-adult height = 171.59 *cm*); target height computed using formula for males, h_{PGF} and h_{PGM} are heights of paternal grandfather and paternal grandmother, respectively, measured in *cm* (Tanner *et al.*, 1970)**:**

$$\textit{Target Height of Father}\ (cm) = \frac{h_{PGF} + h_{PGM} + 13}{2} = \frac{171.59 + 150.27 + 13}{2} = 167.43\ cm$$

Table 8*b*. Height-gain-target-achievement index, h_C, and mass-management-target-achievement index, μ_C, of father at his 2nd simulated checkup

February 5, 2009	*Height*		*Mass* (*Weight*)	
	cm	*ft-in*	*kg*	*lb-oz*
Values at 2nd Simulated Checkup	**170.10**	**5 *ft* 6.97 *in***	**59.40**	**130 *lb* 15.63 *oz***
Recommended by Roadmap 5.0	174.75	5 *ft* 8.50 *in*	66.41-71.29	146 *lb* 6.83 *oz* - 157 *lb* 3.05 *oz*
Target-Achievement Index	98.19 %		86.74 % ↓	
Qualitative	h_C under-achieved		μ_C under-achieved¥	

¥Lesser mass outside the normal range

deceased scientist *Prominent Physicist Professor Dr. Khursheed Athar Siddiqui Departs* https://pakistanlink.org/Commentary/2022/Oct22/14/13.HTM

REFERENCES

Andrsen, C. T., C. Langendorf, S. Garba, *et al.* (2022). Risk of community- and hospital-acquired bacteremia and profile of antibiotic resistance in children hospitalized with severe acute malnutrition in Niger. *International Journal of Infectious Diseases*, 119**:** 163-171. https://doi.org/10.1016/j.ijid.2022.03.047

Arflin, R., Rodiyah and F. R. A. Putri (2020). The legal and social aspect for underage marriage women's education rights in the perspective of human rights**:** contemporary issues and problems. *SAWWA***:** *Jurnal Studi Gender*, 15 (2)**:** 219-240. https://doi.org/10.21580/sa.v15i2.5165

Argelich, E., M. E. Alemany, B. Amengual-Miralles, *et al.* (2021). Paediatric teams in front of childhood obesity**:** a qualitative study within the STOP Project. *Anales de Pediatría* (*English Edition*), 95 (3)**:** 174-185. https://doi.org/10.1016/j.anpede.2020.11.004

Barber, C. (2017). Rare health conditions 7**:** diabulimia, precarious puberty, intersex/hermaphrodite. *British Journal of Healthcare Assistants*, 11 (12)**:** 582-585. https://doi.org/10.12968/bjha.2017.11.12.582

Bramante, C. T., R. L. J. Thomson, W. L. Bennett, *et al.* (2019). Systematic review of natural experiments for childhood obesity prevention and control. *American Journal of Preventive Medicine*, 56 (1)**:** 147-158. https://doi.org/10.1016/j.amepre.2018.08.023

Brock, D-J. P., P. A. Estabrooks, H. M. Maurer, *et al.* (2019). Building and sustaining capacity to address childhood obesity**:** a 3-*year* mixed-methods case study of a community-academic advisory board. *Family and Community Health*, 42 (1)**:** 62-79. https://doi.org/10.1097/FCH.0000000000000212

Cazes, C., K. Phelan, V. Hubert, *et al.* (2022). Simplifying and optimising the management of uncomplicated acute malnutrition in children aged 6-59 months in the Democratic Republic of the Congo (OptiMA-DRC)**:** a non-inferiority, randomized controlled trial. *The Lancet Global Health*, 10 (4)**:** e510-e520. https://doi.org/10.1016/S2214-109X(22)00041-9

Chantler, K., G. Gangoli and M. Hester (2009). Forced marriage in the UK**:** religious, cultural, economic or state violence? *Critical Social Policy*, 29 (4)**:** 587-612. https://doi.org/10.1177/0261018309341905

Cheng, E. R., R. Steinhart and Z. B. Miled (2022). Predicting childhood obesity using machine learning**:** practical considerations. *BiomedInformatics*, 2 (1)**:** 184-203. https://doi.org/10.3390/biomedinformatics2010012

Table 8*c*. Month-wise height-gain targets as well as month-wise mass-management and weight-management target-ranges for father based on his 2nd simulated checkup

Target Date	*Height-Gain Target*		*Mass-Management and Weight-Management Target-Ranges*	
	cm	*ft-in*	*kg*	*lb-oz*
February 5, 2009 (reference)	**170.10**	**5 *ft* 6.97 *in***	**59.40**	**130 *lb* 15.63 *oz***
March 5, 2009 (1st month)	170.87	5 *ft* 7.27 *in*	60.63-61.40	133 *lb* 11.12 *oz* - 135 *lb* 6.32 *oz*
April 5, 2009 (2nd month)	171.73	5 *ft* 7.61 *in*	62.00-63.62	136 *lb* 11.26 *oz* - 140 *lb* 4.58 *oz*
May 5, 2009 (3rd month)	172.56	5 *ft* 7.94 *in*	63.32-65.76	139 *lb* 9.85 *oz* - 145 *lb* 0.31 *oz*
June 5, 2009 (4th month)	173.41	5 *ft* 8.27 *in*	64.68-67.99	142 *lb* 10.00 *oz* - 149 *lb* 14.57 *oz*
July 5, 2009 (5th month)	174.24	5 *ft* 8.60 *in*	66.00-70.13	145 *lb* 8.59 *oz* - 154 *lb* 10.30 *oz*
August 5, 2009 (6th month)	175.14	5 *ft* 8.95 *in*	67.43-72.46	148 *lb* 11.07 *oz* - 159 *lb* 12.35 *oz*

Table 9*a*. Growth-and-Obesity Scalar-Roadmap 5.0 of mother (SGPP-KHI-20080104-01/simulated)

Date of Birth (*year-month-day*)**:** 1992-12-30

*Adult-Army-Cut-off Height***:** 157.48 *cm* (19.36^{P}) • *Adult-Median Height***:** 160.69 *cm* (34.85^{P})

Simulated Checkup	*1st*	*2nd*
Date of Checkup (*year-month-day*)	2008-08-10	2009-02-05
Time of checkup (*a. m.*)	09**:** 00	09**:** 45
Age (*year-month-day*)	15-07-10	16-01-05
Age (*decimal year*)	15.61	16.10
Height (*cm*) ⇐	157.00	157.00
Height (*ft-in*)	5 *ft* 1.81 *in*	5 *ft* 1.81 *in*
CDC Percentile-of-Height ⇔	21.31^{P}	20.30^{P}
Modified-Scaled Percentile-of-Height	32.50^{P}	31.10^{P}
Current-Age-Army-Cut-off Height (*cm*) ⇐	156.49	156.75
Difference of Height and Current-Age-Army-Cut-off Height (*cm*)	+11.71	+0.25
Current-Age-Median Height (*cm*) ⇐	159.68	159.95
Difference of Height and Current-Age-Median Height (*cm*)	–2.68	–2.95
Target (Adult-Mid-Parental) Height (*cm*)	157.55[§]	157.55
Percentile-of-Mid-Parental-Height	19.62^{P}	19.62^{P}
Current-Age-Mid-Parental Height (*cm*) ⇐	156.56	156.82
Difference of Height and Current-Age-Mid-Parental Height (*cm*)	+11.64	+0.18
Estimated-Adult Height (*cm*)	158.00	157.73
Estimated-Adult Height (*ft–in*)	**5 *ft* 2.20 *in***	**5 *ft* 2.10 *in***
Refined Status (pertaining-to-height)	0	0
Depictive Status (pertaining-to-height)	**Normal**	**Normal**
Net Mass (*kg*) ⇒	**52.50**	**53.10**
Net Weight (*lb-oz*)	127 *lb* 0.13 *oz*	130 *lb* 15.63 *oz*
CDC Percentile-of-Mass ⇔	**46.56^{P}**	**45.67^{P}**
Modified-Scaled Percentile-of-Mass	77.68^{P}	77.01^{P}
Percentile-of-Reference-*BMI*-based-Optimal-Mass ⇔	62.29^{P}	62.29^{P}
Corrected-Reference-*BMI*-based-Optimal Mass (*kg*)[¶] ⇒	61.81	62.57
Difference of Mass and Reference-*BMI*-based-Optimal Mass (*kg*)	–9.31	–9.47
Corrected-Height-Percentile-based-Optimal Mass (*kg*)[¶] ⇒	51.92	52.53
Difference of Mass and Height-Percentile-based-Optimal Mass (*kg*)	+0.58	+0.57
Estimated-Adult Mass (*kg*)	57.50	57.23
Estimated-Adult Weight (*lb–oz*)	126 *lb* 10.10 *oz*	126 *lb* 2.91 *oz*
Refined Status (pertaining-to-mass)	0	0
Depictive Status (pertaining-to-mass)	**Normal**	**Normal**
Away-from-Normality Index	0	0
Polar Angle (*degree*)	Indeterminate	Indeterminate
Enhanced-Nutritional Status	**Normality**	**Normality**
Estimated-Adult *BMI* (*kg*/*m*^{2})	23.01	23.00
Estimated-Adult-Specific *BMI*	0.959	0.958
Build	**Medium**	**Medium**

[§] Paternal grandmother of T. H. and Z. H. is above the age of 19 *years* (measured height = estimated-adult height = 157.49 *cm*); paternal grandfather is above the age of 21 *years* (measured height = estimated-adult height = 170.61 *cm*); target height computed using formula for males, h_{MGF} and h_{MGM} are heights of paternal grandfather and paternal grandmother, respectively, measured in *cm* (Tanner *et al.*, 1970)**:**

$$\textit{Target Height of Mother}\ (cm) = \frac{h_{MGF} + h_{MGM} + 13}{2} = \frac{157.49 + 170.61 - 13}{2} = 157.55\ cm$$

[¶] 5 *kg* mass is added to mother's reference-*BMI*-based-optimal mass and reference-height-percentile-based-optimal mass to account for possible pregnancy and the associated mass of fetus. No correction needed for father and children.

Table 9*b*. Height-gain-target-achievement index, h_C, and mass-management-target-achievement index, μ_C, of mother at her 2nd simulated checkup

February 5, 2009	*Height*		*Mass* (*Weight*)	
	cm	*ft-in*	*kg*	*lb-oz*
Values at 2nd Simulated Checkup	**170.10**	**5 *ft* 6.97 *in***	**59.40**	**130 *lb* 15.63 *oz***
Recommended by Roadmap 5.0	174.75	5 *ft* 8.50 *in*	66.41-71.29	146 *lb* 6.83 *oz* - 157 *lb* 3.05 *oz*
Target-Achievement Index	98.19 %		86.74 % ↓	
Qualitative	h_C under-achieved		μ_C under-achieved$^{\in}$	

$^{\in}$Lesser mass outside the normal range

Clark, B. and C. Richards (2008). The prevention and prohibition of forced marriages — a comparative approach. *International and Comparative Law Quarterly*, 57 (3)**:** 501-528. https**:**//doi.org/10.1017/S0020589308000390

Fowler, L. A., A. C. Grammer, A. E. Staiano, *et al.* (2021*a*). Harnessing technological solutions for childhood-obesity prevention and treatment**:** a systematic review and meta-analysis of current applications. *International Journal of Obesity*, 45 (5)**:** 957–981. https**:**//doi.org/10.1038/s41366-021-00765-x

Fowler, L. A., S. E. Hampl, M. L. D. Gillette, *et al.* (2021*b*). Translating family-based behavioral treatment for childhood obesity into a user-friendly digital package for delivery to low-income families through primary care partnerships**:** the MO-CORD Study. *Obesity*, 17 (Supplement 1)**:** S30-S38. https**:**//doi.org/10.1089/chi.2021.0174

Gastón, C. M., C. Misunas and C. Cappa (2019). Child marriage among boys**:** a global overview of available data. *Vulnerable Children and Youth Studies*, 14 (3)**:** 219-228. https://doi.org/10.1080/17450128.2019.1566584

Ickovics, J. R., K. O. Duffany, F. M. Shebl, *et al.* (2019). Implementing school-based policies to prevent obesity**:** cluster randomized trial. *American Journal of Preventive Medicine*, 56 (1)**:** e1-e11. https**:**//doi.org/10.1016/j.amepre.2018.08.026

Kamal, S. A. (2010, March 22). Mathematics in the life sciences. *The First National Conference on Mathematical Sciences*, Golden Jubilee Celebration, Department of Mathematics, University of Karachi, Karachi, Pakistan, p. 19 (the Syed Firdous memorial lecture), abstract#10**:** https**:**//www.ngds-ku.org/Presentations/Firdous.pdf

Kamal, S. A. (2015*a*). Acute malnutrition in a child suffering from cardiac problems. *International Journal of Biology and Biotechnology*, 12 (4)**:** 585-600, full text**:** https**:**//www.ngds-ku.org/Papers/J40.pdf

Kamal, S. A. (2015*b*). Optimal-mass management in obese children. *International Journal of Biology and Biotechnology*, 12 (3)**:** 381-391, full text**:** https**:**//www.ngds-ku.org/Papers/J38.pdf

Kamal, S. A. (2016, April 7). *Manual for Obtaining Anthropometric Measurements.* The-NGDS-Pilot-Project-e-Publication, University of Karachi, Karachi, Pakistan, version 9.11, full text**:** https**:**//www.ngds-ku.org/ngds_folder/M02.pdf

Kamal, S. A. (2017*a*). In search of a definition of childhood obesity. *International Journal of Biology and Biotechnology*, 14 (1)**:** 49-67, full text**:** https**:**//www.ngds-ku.org/Papers/J45.pdf

Kamal, S. A. (2017*b*). Integration of *BMI*-based-optimal mass and height-percentile-based-optimal mass to propose the sixth-generation solution of childhood obesity. *International Journal of Biology and Biotechnology*, 14 (4)**:** 485-502, full text**:** https**:**//www.ngds-ku.org/Papers/J49.pdf

Table 9*c*. Month-wise height-gain targets as well as month-wise mass-management and weight-management target-ranges for mother based on her 2nd simulated checkup

Target Date	*Height-Gain Target*		*Mass-Management and Weight-Management Target-Ranges*	
	cm	*ft-in*	*kg*	*lb-oz*
February 5, 2009 (reference)	**157.00**	**5 *ft* 1.81 *in***	**53.10**	**117 *lb* 1.37 *oz***
March 5, 2009 (1st month)	157.48	5 *ft* 2.00 *in*	53.62-54.65	118 *lb* 3.71 *oz* - 120 *lb* 8.02 *oz*
April 5, 2009 (2nd month)	158.02	5 *ft* 2.21 *in*	54.20-56.36	119 *lb* 8.01 *oz* - 124 *lb* 4.52 *oz*
May 5, 2009 (3rd month)	158.53	5 *ft* 2.41 *in*	54.75-58.02	120 *lb* 11.66 *oz* - 127 *lb* 15.07 *oz*
June 5, 2009 (4th month)	159.07	5 *ft* 2.62 *in*	55.33-59.74	121 *lb* 15.96 *oz* - 131 *lb* 11.57 *oz*
July 5, 2009 (5th month)	159.58	5 *ft* 2.83 *in*	55.88-61.40	123 *lb* 3.61 *oz* - 135 *lb* 6.12 *oz*
August 5, 2009 (6th month)	160.14	5 *ft* 3.05 *in*	56.49-63.20	124 *lb* 8.89 *oz* - 139 *lb* 5.55 *oz*

Table 10. Instantaneous and true obesity/wasting as well as instantaneous and true tallness/stunting (Kamal *et al.*, 2021*b* — Tables 7-10) during each simulated checkup of parents

Simulated Checkup	*Father*		*Mother*	
	1st	*2nd*	*1st*	*2nd*
Instantaneous Tallness	Absent	Absent	Absent	Absent
True Tallness	Absent	Absent	Absent	Absent
Instantaneous Stunting	Absent	Absent	Absent	Absent
True Stunting	Present	Present	Present	Present
Instantaneous Obesity	Absent	Absent	Absent	Absent
True Obesity	Absent	Absent	Absent	Absent
Instantaneous Wasting	Present	Present	Absent	Absent
True Wasting	Present	Present	Absent	Absent
True Over-Nutrition	Absent	Absent	Absent	Absent
True Energy-Channelization I	Absent	Absent	Absent	Absent
True Under-Nutrition	Present	Present	Absent	Absent
Acute Malnutrition	Absent	Absent	Absent	Absent
True Energy-Channelization II	Absent	Absent	Absent	Absent

Kamal, S. A. (2022*a*). Growth-and-Obesity Vector-Roadmap 2.6 of a child perceived to be severely stunted. *International Journal of Biology and Biotechnology*, 19 (3)**:** 289-304, full text**:** https**://**www.ngds-ku.org/Papers/J65.pdf

Kamal, S. A. (2022*b*). Prevalence of acute malnutrition in children of Karachi determined from their Growth-and-Obesity Roadmaps 4.5 — the tenth-generation solution of childhood obesity-and-malnutrition. *International Journal of Biology and Biotechnology*, 19 (3)**:** 451-467, full text**:** https**://**www.ngds-ku.org/Papers/J67.pdf

Additional File 1 — Color-Coding used in Growth-and-Obesity Roadmaps 4.5**:** https**://**www.ngds-ku.org/Papers/J67/Additional_File_1.pdf

Additional File 2 — Methods of Construction of Roadmaps 4.5**:** https**://**www.ngds-ku.org/Papers/J67/Additional_File_2.pdf

Kamal, S. A. (2022*c*). Solutions of childhood obesity-and-malnutrition (guest editorial). *The Sky* (*International Journal of Physical Education*, *Health and Sports Sciences*), 6**:** i, ii, full text**:** https**://**www.ngds-ku.org/Papers/J68.pdf

Kamal, S. A. and A. A. Naz (2021). Cut-off heights for induction into the Armed Forces of Pakistan**:** adequacy of criteria for still-growing youth. *Anthological Notebooks*, 26 (1)**:** 14-27, full text**:** https**://**www.ngds-ku.org/Papers/J64.pdf

Kamal, S. A., A. A. Naz and S. A. Ansari (2016*a*). Growth-and-Obesity Vector-Roadmaps of the Pakistani children. *International Journal of Biology and Biotechnology*, 13 (4)**:** 651-671, full text**:** https**://**www.ngds-ku.org/Papers/J43.pdf

Additional File 1 — Checkup Protocols**:** https**://**www.ngds-ku.org/Papers/J43/Additional_File_1.pdf

Kamal, S. A., A. A. Naz and S. A. Ansari (2017*a*). Possible validation of mathematical definition of childhood obesity based on anthropometric data collected during 1998-2013. *International Journal of Biology and Biotechnology*, 14 (2)**:** 219-235, full text**:** https**://**www.ngds-ku.org/Papers/J46.pdf

Kamal, S. A., A. A. Naz, S. Musafar and S. A. Ansari (2016*b*, February 12, 13). Growth-and-Obesity Vector-Roadmaps using enhanced anthropometric instruments**:** the fourth-generation solution of childhood obesity. *The Karachi Physics Society First National Conference on Multidisciplinary Topics in Physics*, Department of Physics, University of Karachi, Karachi, Pakistan, p. 56 (invited lecture), abstract#IT-04**:** https**://**www.ngds-ku.org/Presentations/Vector.pdf

Kamal, S. A., H. I. Azeemi and S. R. Khan (2017*b*). Psychological testing, physical examination and fitness testing of primary-school students for participation in gymnastic activities. *Pamukkale Journal of Sport Sciences*, 8 (2)**:** 15-40, full text**:** https**://**www.ngds-ku.org/Papers/J48.pdf

Kamal, S. A., M. J. Ansari, M. Sarwar, S. A. Ansari, A. A. Naz and N. Jamil (2021*a*). Percentiles of height-and-mass scaled for the Pakistani population**:** application to determine build of a gymnast. *Uluslararası Bozok Sport Bilimleri Dergisi* (*Bozok International Journal of Sport Sciences*), 2 (1)**:** 33-57, full text**:** https**://**www.ngds-ku.org/Papers/J60.pdf

Table 11. Lifestyle adjustment, diet and exercise plans for parents

	Height Management	*Mass* (*Weight*) *Management*
Lifestyle Adjustment	2-3-*hour* family time on a daily basis, with cell phones and tablets kept away (conversation — educating children about environmental-resource preservation**:** trees and forests, water reservoirs, clean-fresh air, plastic pollution; religious tolerance; ethnic diversity; empathy to feeling of others; joy of sharing); strolling in the park; relaxing on benches; active and carefree lifestyle; recommended daily dose of vitamin D (600 IU) through 10-15-*minute* guarded-graduated sun-exposure (early morning or late afternoon) with parents dress lightly in indoor clothing; lesser screen time — computer monitor at eye level, neck and back straight as well as normal to thighs; pure cotton undergarments and socks (dis-infectant powder to be applied to dry body parts and wiped feet before putting on underwear/ socks), pure leather mocation shoes with foot support — tight undergarments, clothes, shoes and slippers (flip-flops) should not be worn, slippers got wet during ablution should be replaced immediately with dry ones to be put on carefully dried and wiped feet, between toes (same goes with clothes drenched in rain); mothers should put on high heels only during parties — cause toes to bend inward; outdoor activities combined with light reading and social interactions; 6-*hour* night-time sound sleep, before retiring to bed, mother should have hair unbraided and opened up, for safety reasons all hair accessories, jewelry, watch, belt removed; glass of milk consumed before bedtime; teeth brushed 5 times — upon rising, after breakfast, lunch and dinner each as well as before going to bed; additional brushing after consuming candies/ chocolates/cookies/juices/milk	
Diet Plans	3 relaxed (wait for food, not let the food wait for you; no eating/drinking while walking or standing; eat when very hungry, abstain when some appetite remains) and balanced meals, should include fresh fruits and green vegetables; 10-12 glasses of water daily; only one 250-*ml* bottle of carbonated drink[&] within a *month* — plastic shoppers should not be used to pack food items, in particular, carbonated drinks/tea/ coffee; do not forget to check expiry date for packed food and drink items	
	To gain height, diet plan should include calcium-, protein- and fiber-rich diet (chicken, fish, fresh fruit and milk)	To put on mass (weight), diet plan of parents should include milk, potato items (baked/boiled, not fried) and protein-rich diet
Exercise Plans	Exercises for 5 *minutes* each after waking up, at the end of every hour and before going to bed — bending on sides, focusing eyes far away and moving eyeballs, moving fingers and wrists after computer work writing, stretching, touching toes without flexing knees, exercising neck muscles (left, right, up, down), light exercises during TV/DVD watching; guarded-graduated© structured exercises, preceded by warm-up and followed by cool-down routines, preferably outdoors (weather permitting) in exercise-friendly clothing (form-fitting, made of absorbent material); table tennis; jogging; cycling	
	To pick up height, parents should perform light-stretching exercises	To increase mass (weight), parents should perform heavy exercises for shorter duration, consistently

[&]Carbonated drinks take away body's capacity to absorb calcium and iron and hence should be avoided by persons of all ages, in particular, children and older individuals

Additional File 1 — Techniques of Anthropometric Measurements (step-by-step procedures illustrated through labeled photographs)**:** https://www.ngds-ku.org/Papers/J60/Additional_File_1.pdf

Additional File 4 — Lifestyle adjustment, diet and exercise plans**:** https://www.ngds-ku.org/Papers/J60/Additional_File_4.pdf

Kamal, S. A., M. J. Ansari, S. A. Ansari and A. A. Naz (2020). Two-parameter (height and mass) problem solved by fitting parabolic curve to construct Growth-and-Obesity Vector-Roadmap 3.0 — the eighth-generation solution of childhood obesity. *International Journal of Biology and Biotechnology*, 17 (1)**:** 23-57, full text**:** https://www.ngds-ku.org/Papers/J54.pdf

Kamal, S. A., M. K. Rajput, A. A. Naz and N. Jamil (2021*b*). Growth-and-Obesity Roadmaps 4.0 of the Pakistani children — the ninth-generation solution of childhood obesity. *International Journal of Biology and Biotechnology*, 18 (1)**:** 123-145, full text**:** https://www.ngds-ku.org/Papers/J59.pdf

Kamal, S. A., N. Jamil and S. A. Ansari (2018). Validation of concept of optimal mass in children and adults — the seventh-generation solution of childhood obesity. *International Journal of Biology and Biotechnology*, 15 (4)**:** 613-638, full text**:** https://www.ngds-ku.org/Papers/J52.pdf

Table 12. Time slots, valid for the city of Karachi, Pakistan, for full body[δ] sun-exposure[ε] of Z. H. and T. H. as well as their growing parents during the 6-*month* period following their 2nd simulated checkups to obtain the required doses of vitamin D

Date	*Safe Period*[ϕ] (*a. m.* – *a. m.*)	*Intermittent Period*[χ] (*a. m.* – *a. m.*)	*Prohibited Period* (*a. m.*- *p. m.*)	*Intermittent Period* (*p. m.* – *p. m.*)	*Safe Period* (*p. m.* – *p. m.*)
MARCH					
01	6: 55 - 8: 11	8: 12 - 9: 28	9: 29 - 4: 00	4: 01 - 5: 17	5: 18 - 6: 34
15	6: 41 - 7: 53	7: 54 - 9: 06	9: 07 - 4: 15	4: 16 - 5: 28	5: 29 - 6: 41
APRIL					
01	6: 24 - 7: 38	7: 39 - 8: 53	8: 54 - 4: 18	4: 19 - 5: 33	5: 34 - 6: 48
15	6: 10 - 7: 26	7: 27 - 8: 43	8: 44 - 4: 20	4: 21 - 5: 37	5: 38 - 6: 54
MAY					
01	5: 56 - 7: 15	7: 16 - 8: 35	8: 36 - 4: 22	4: 23 - 5: 42	5: 43 - 7: 02
15	5: 48 - 7: 08	7: 09 - 8: 29	8: 30 - 4: 27	4: 28 - 5: 48	5: 49 - 7: 09
JUNE					
01	5: 42 - 7: 06	7: 07 - 8: 31	8: 32 - 4: 17	4: 18 - 5: 52	5: 53 - 7: 17
15	5: 41 - 7: 03	7: 04 - 8: 26	8: 27 - 4: 37	4: 38 - 6: 00	6: 01 - 7: 23
JULY					
01	5: 45 - 7: 07	7: 08 - 8: 30	8: 31 - 4: 40	4: 41 - 6: 03	6: 04 - 7: 26
15	5: 51 - 7: 12	7: 13 - 8: 34	8: 35 - 4: 41	4: 42 - 6: 03	6: 04 - 7: 25
AUGUST					
01	5: 59 - 7: 19	7: 20 - 8: 40	8: 41 - 4: 35	4: 36 - 5: 56	5: 57 - 7: 17
15	6: 06 - 7: 24	7: 25 - 8: 43	8: 44 - 4: 29	4: 30 - 5: 48	5: 49 - 7: 07

[δ]Z. H. and T. H. barefooted, bareheaded, dressed in short underpants only (all clothing above the waist removed), hair opened up, eyes protected through UV-cut-off glasses, engaged in light exercises/free play; if sitting for drawing, jigsaw puzzles, painting, singing, story-telling/listening, their backs should be towards the sun); parents in light indoor clothing

[ε]10-15-*minute* guarded-graduated sun exposure (Kamal and Khan, 2018)

[ϕ]Safe-exposure duration is when the sun has not reached 18^o after rising or is at an angle less than 18^o before setting; children may be exposed to direct sunlight (suitable for summer months)

[χ]Intermittent-exposure duration is when the sun is at an angle between 18^o and 36^o (end-points included) after rising or between 36^o and 18^o (end-points included) before setting; children may be allowed to play in the shade with brief periods of sun exposure (suitable for winter months); 12-*month* table for Karachi, Sindh, Pakistan is available elsewhere (Kamal and Khan, 2020 — Table 6)

Kamal, S. A., N. Jamil and S. A. Khan (2011). Growth-and-Obesity Profiles of children of Karachi using box-interpolation method. *International Journal of Biology and Biotechnology*, 8 (1)**:** 87-96, full text**:** https**://**www.ngds-ku.org/Papers/J29.pdf

Kamal, S. A., S. A. Ansari and S. S. Jamil (2014*a*, September 4). Growth-and-Obesity Enhanced-Roadmaps of children. *The Second Conference on Anthromathematics and Sport Mathematics in the Memory of* (*Late*) *Hussain Ahmed Bilgirami* (*ANTHROMATHEMATICS 2014*), Department of Mathematics, University of Karachi, Karachi, Pakistan and Government College, Hyderabad, Pakistan, p. 10 (concluding talk), abstract# Anthro14-06**:** https**://**www.ngds-ku.org/Presentations/Enhanced.pdf

Kamal, S. A., S. A. Ansari and S. S. Jamil (2015). Generating and validating Growth-and-Obesity Roadmaps for the Pakistani children. *International Journal of Biology and Biotechnology*, 12 (1)**:** 47-61, full text**:** https**://**www.ngds-ku.org/Papers/J35.pdf

Kamal, S. A. and S. A. Khan (2018). Overcoming vitamin-D deficiency in male gymnasts during preteen *years*. *The Sky* (*International Journal of Physical Education*, *Health*, *Sports and Allied Sciences*), 2**:** 60-75, full text**:** https**://**www.ngds-ku.org/Papers/J50.pdf

Kamal, S. A. and S. A. Khan (2020). Association of balanced diet and physical activity with fitness of young children and their parents. *The Shield* (*Research Journal of Physical Education and Sports Science*), 15**:** 119-147, full text**:** https**://**www.ngds-ku.org/Papers/J58.pdf

Kamal, S. A. and S. S. Jamil (2012). A method to generate Growth-and-Obesity Profiles of still-growing parents. *International Journal of Biology and Biotechnology*, 9 (3)**:** 233-255, full text**:** https**://**www.ngds-ku.org/Papers/J30.pdf

Kamal, S. A. and S. S. Jamil (2014). KJ-regression model to evaluate optimal masses of extreme cases. *International Journal of Biology and Biotechnology*, 11 (4)**:** 623-648, full text**:** https**://**www.ngds-ku.org/Papers/J34.pdf

Additional File 3 — Extended Growth Tables and Extended Growth Charts**:** https**://**www.ngds-ku.org/Papers/J34/Additional_File_3.pdf

Kamal, S. A., S. S. Jamil and S. A. Ansari (2013, September 4, 5). Growth-and-Obesity Roadmaps of children. *The First Conference on Anthromathematics in the Memory of* (*Late*) *Syed Firdous* (*ANTHROMATHEMATICS 2013*), Department of Mathematics, University of Karachi, Karachi, Pakistan and Government College, Hyderabad, Pakistan, p. 8, abstract#Anthro13-02**:** https**://**www.ngds-ku.org/Presentations/Roadmap.pdf

Kamal, S. A., S. S. Jamil and U. A. Razzaq (2014*b*). Stunting induced by wasting — wasting induced by stunting**:** a case study. *International Journal of Biology and Biotechnology*, 11 (1)**:** 147-153, full text**:** https**://**www.ngds-ku.org/Papers/J32.pdf

Keys, A., F. Fidanza, M. J. Karvonen, N. Kimura and H. L. Taylor (1972). Indices of relative weight and adiposity. *Journal of Chronic Diseases*, 25 (6&7)**:** 329-343). https**://**doi.org/10.1016/0021-9681(72)90027-6

Kolimechkov, S. and L. Petrov (2020). The body-mass index**:** a systematic review. *Journal of Exercise Physiology and Health*, 3 (2)**:** 21-27, full text**:** https**://**www.ngds-ku.org/Papers/J67/BMI.pdf

Mikhailin, E. S. and L. A. Ivanova. (2019). Features of the state of newborns born to underage mothers. *Rossiyskiy Vestnik Perinatologii i Pediatrii* (*Russian Bulletin of Perinatology and Pediatrics*), 64 (4)**:** 35-37 (in Russian). https**://**doi.org/10.21508/1027-4065-2019-64-4-35-37

Mulugeta, A. and M. Gebregiabher (2022). Saving children from man-made acute malnutrition in Tigray, Ethopia**:** a call to action. *The Lancet Global Health*, 10 (4)**:** e469-e470. https**://**doi.org/10.1016/S2214-109X(22)00023-7

Ouattara, M., P. Sen and M. Thomson (1998). Forced marriage, forced sex**:** the perils of childhood for girls. *Gender and Development*, 6 (3)**:** 27-33. https**://**doi.org/10.1080/741922829

Ozer, E., M. C. Nacar, A. Yildirim, O. Enginyurt, H. Din and D. Evucman (2014). Underage mothers in Turkey. *Medical Science Monitor*, 20**:** 582-586. https**://**doi.org/10.12659/MSM.890341

Prettitore, P. S. (2015). Family law reform, gender equality and underage marriage**:** a view from Morocco and Jordan. *The Review of Faith and International Affairs*, 13 (3)**:** 32-40. https**://**doi.org/10.1080/15570274.2015.1075758

Razi, M. and A. Nasiri (2022). Concerns of parents about children's overweight and obesity during the COVID-19 pandemic**:** a qualitative study. *Journal of Pediatric Nursing*, 63**:** 111-116. https**://**doi.org/10.1016/j.pedn.2021.11.012

Tanner, J. M., H. Goldstein and R. H. Whitehouse (1970). Standards for children's height at ages 2-9 *years* allowing for height of parents. *Archives of Diseases of Children*, 45 (244)**:** 755-762. https**://**doi.org/10.1136/adc.45.244.755

Villa-Cruz, G. A., C. E. Hernández-Escobar, D. González-Oropeza, I. Apodaca-Ramos and C. P. González (2019). Adolscent pregnancy and school grade**:** higher level than my mother but good enough? A cross-sectional study in Mexico. *Journal of Pediatric and Adolescent Gynecology*, 32 (2)**:** 211-212. https**://**doi.org/10.1016/j.jpag.2019.02.045

Vonasek, B. J., K. K. Radtke, P. Vaz, *et al.* (2022). Tuberculosis in children with severe acute malnutrition. *Expert Review of Respiratory Medicine*, 16 (3)**:** 273-284. https**://**doi.org/10.1080/17476348.2022.2043747

Wilfley, D. E., L. A. Fowler, L. A., S. E. Hampl, *et al.* (2021). Implementation of a scalable family-based behavioral treatment for childhood obesity delivered through primary-care clinics**:** description of the Missouri Childhood Obesity Research Demonstration Study Protocol. *Childhood Obesity*, 17 (S1)**:** S39–S47. https**://**doi.org/10.1089/chi.2021.0175

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