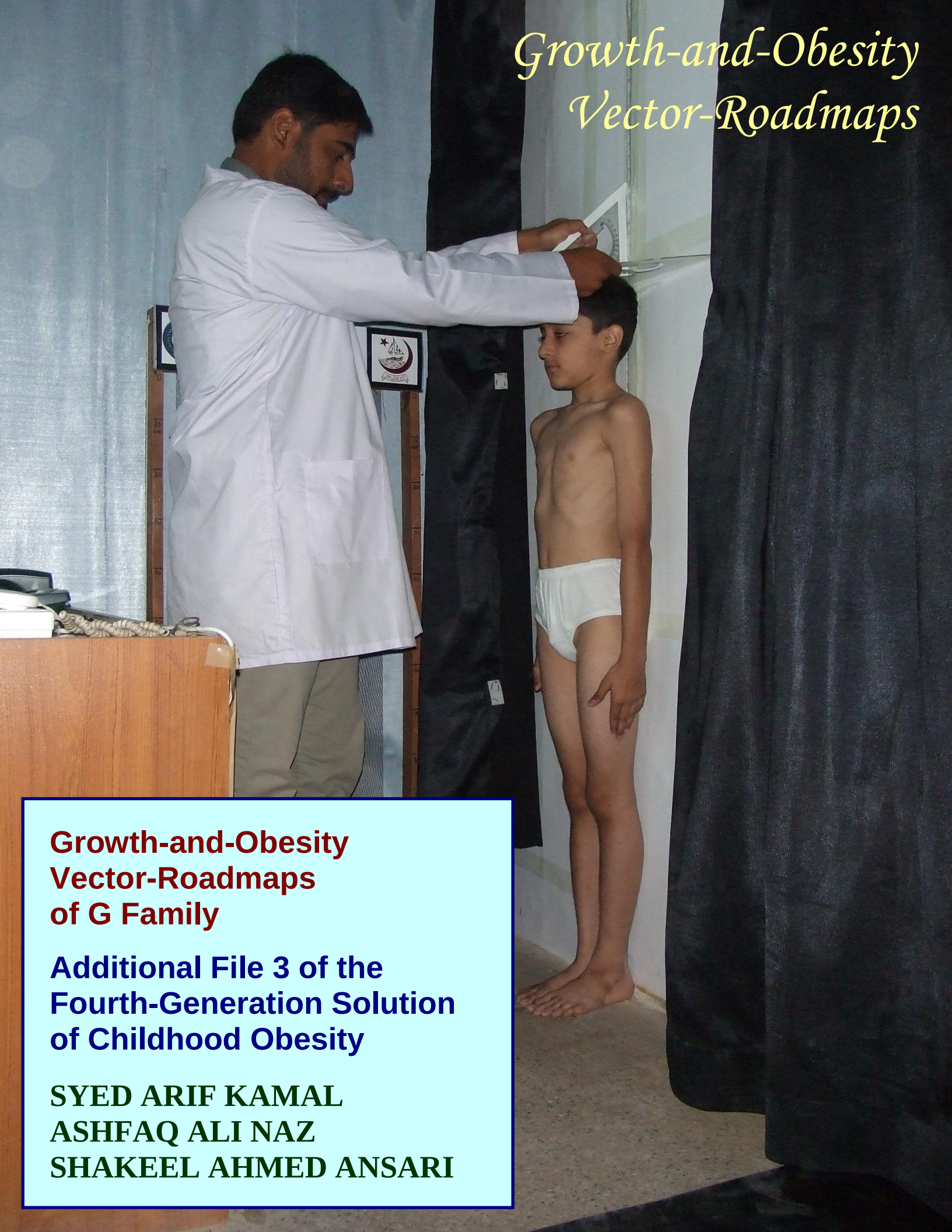

Growth-and-Obesity Vector-Roadmaps of G Family

Additional File 3 of the Fourth-Generation Solution of Childhood Obesity

SYED ARIF KAMAL
ASHFAQ ALI NAZ
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University of Karachi
THE NGDS PILOT PROJECT
The Sibling Growth Pilot Project
SF GROWTH-AND-IMAGING LABORATORY

GROWTH-AND-OBESITY VECTOR-ROADMAPS OF THE PAKISTANI CHILDREN

*Syed Arif Kamal**, *Ashfaq Ali Naz* and *Shakeel Ahmed Ansari*

https://www.ngds-ku.org/Papers/J43.pdf

This is the format of the report generated using vector model. Text in BLUE is not part of report handed out to parents of L. G. (header and footer on this page as well as pages 5-12)

Additional File 3: Growth-and-Obesity Vector-Roadmap of L. G.

SGPP Case Number: **SGPP-KHI-20131021-02** • *Date of Report* (*year-month-day*): 2016-03-31
Father's Name: W/H • *Mother's Name*: W/H • *e-mail*: W/H • *Paper Mail*: W/H
Telephone: W/H • *Best time to Call*: 11 am on Saturday

Table-AFIII-1: Adult-mid-parental (Target) and army-cutoff heights

Father's Height: 167.16 *cm* • *Mother's Height*: 160.16 *cm*

Adult-Mid-Parental (Target) and Army-Cutoff Heights	*Boy*		*Girl*	
	Target	*Army-Cutoff*	*Target*	*Army-Cutoff*
Height (*cm*)	170.16	162.56	157.16	157.48
Height (*ft-in*)	5 *ft* 6.99 *in*	5 *ft* 4.00 *in*	5 *ft* 1.87 *in*	5 *ft* 2.00 *in*
Percentile	18.95	2.72	18.14	19.36

cm: centimeter(s) • *ft*: foot (feet) • *in*: inch(es) • *kg*: kilogram(s) • *lb*: pound(s) • *oz*: ounce(s)
MP: Mid-Parental • NA: Not Available • NM: Not Measured • W/H: Withheld to protect privacy

EC I: Energy-Channelization I (Tallness + Wasting) • EC II: Energy-Channelization II (Stunting + Obesity)
EC III: Energy-Channelization III (Puberty-Induced Energy-Channelization) • AM: Acute Malnutrition
ON: Over-Nutrition (Tallness + Obesity) • UN: Under-Nutrition (Stunting + Wasting)

a) The mother, accompanied by father, could come and discuss strategies for long-term-health protection of their child(ren), on:
Tuesday, **April 5, 2016** at **1730h**

b) For explanation of dress and behavior codes see *Manual for Anthropometric Measurements*:
https://www.ngds-ku.org/ngds_folder/M02.pdf

c) Optimal mass (weight) is the recommended mass based on current height of the incumbent.

d) WASTED (OBESE) means student has lesser (excess) weight-for-height (do not confuse with everyday meaning of wasted). Detailed guidelines to help maintain optimal weight-for-height are placed at:
https://www.ngds-ku.org/BLA/Weight.pdf

e) If the data are divided into 100 equal parts, each part represents percentile and gives ranking in the sample chosen to collect data.

f) Estimated-adult height is based on percentile of current height. Adult-mid-parental (Target) height is obtained by adding 6.5 *cm* to (for boys)/ subtracting 6.5 *cm* from (for girls) average of parents' heights (in *cm*).

g) Some helpful suggestions to increase heights of girls, who are considered short-for-age, are available at the link:
https://www.ngds-ku.org/BLA/Height.pdf

h) All diet-based interventions to maintain appropriate weight-for-height and proper height-for-age would be nullified, if children were suffering from vitamin-D deficiency (VDD). The following link lists some indications as well as remedial measures to spot and overcome VDD:
https://www.ngds-ku.org/BLA/VDD.pdf

i) Cumulative-Scoliosis-Risk Weightage (CSRW) above 5.5, 6.5 or 7.5 after the first, the second or the third checkup, respectively, needs careful observation and follow up. CSRW is determined on the basis of the following criteria:
https://www.ngds-ku.org/BLA/Scoliosis_Risk.pdf

j) Guidelines to guard against curvatures of spinal column are placed at:
https://www.ngds-ku.org/Articles/A14.pdf

k) This 'Growth-and-Obesity Vector-Roadmap' is generated according to the procedures given in:
https://www.ngds-ku.org/Papers/J43.pdf

l) Next checkup of your family is scheduled on:
Saturday, **September 24, 2016** at **0937h**

m) Many thanks for your support and understanding of the work done by the NGDS Team.

Prof. Dr. Syed Arif Kamal
Professor and Founding Project Director
e-mail: profdrakamal@gmail.com
*Founding Project Director, the NGDS Pilot Project and Director, SF Growth-and-Imaging Laboratory

Table-AFIII-2*a*: Month-wise height and mass (weight) management for L. G. (SGPP-KHI-20131021-02/01) based on the vector model

Gender: Female ♀ • *Date of Birth*: August 15, 2007 • *School*: W/H • *GR Number*: W/H • *Sport*: Gymnastics

Target Date	*Height Target*		*Mass (Weight) Target*	
	cm	*ft-in*	*kg*	*lb-oz*
March 26, 2016	**147.255**	**4 *ft* 9.97 *in***	**29.975**	**66 *lb* 1.52 *oz***
April 26, 2016	147.77	4 *ft* 10.18 *in*	30.93	68 *lb* 3.30 *oz*
May 26, 2016	148.28	4 *ft* 10.38 *in*	31.84	70 *lb* 3.36 *oz*
6June 26, 2016	148.79	4 *ft* 10.58 *in*	32.98	72 *lb* 11.44 *oz*
July 26, 2016	149.30	4 *ft* 10.79 *in*	34.34	75 *lb* 11.49 *oz*
August 26, 2016	149.82	4 *ft* 10.99 *in*	35.71	78 *lb* 11.80 *oz*
September 26, 2016	150.35	4 *ft* 11.19 *in*	37.04	81 *lb* 10.91 *oz*

Table-AFIII-2*b*: Lifestyle adjustment, diet and exercise plans for L. G. to achieve month-wise targets

	Height Management	*Mass (Weight) Management*
Lifestyle Adjustment	Recommended daily dose of vitamin D (600 IU) through 10-15 minute guarded-graduated sun-exposure (early morning or late afternoon) with the child minimally dressed (leaving head, arms, legs and spinal column exposed, last one from external auditory meatus to hip joint; eyes protected through UV-cutoff glasses); 8-hour, night-time, sound sleep dressed in pajama shorts only (3-minute, slow-stoke back massage to improve quality and quantity of sleep); maximum 2-hour screen time (one hour computer/video games — computer monitor at eye level; one hour TV/DVD) — light exercises during TV/DVD watching; 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 and writing, stretching, touching toes without flexing knees, exercising neck muscles (left, right, up, down)	
Diet Plans	3 relaxed and balanced meals, 10-12 glasses of water daily — absolutely NO carbonated drinks	
	To gain height, diet plan should include calcium-, protein- and fiber-rich diet (milk, fresh fruit, chicken and fish)	To put on mass (weight), diet plan should include milk, potato items (baked or boiled, but not fried) and protein-rich diet
Exercise Plans	Guarded-graduated exercises preceded by warm-up and followed by cool-down routines	
	To pick up height, child should perform light-stretching exercises (bar hanging, mild-stretching, summersault, cartwheel)	To increase mass (weight), heavy exercises performed for shorter duration, consistently

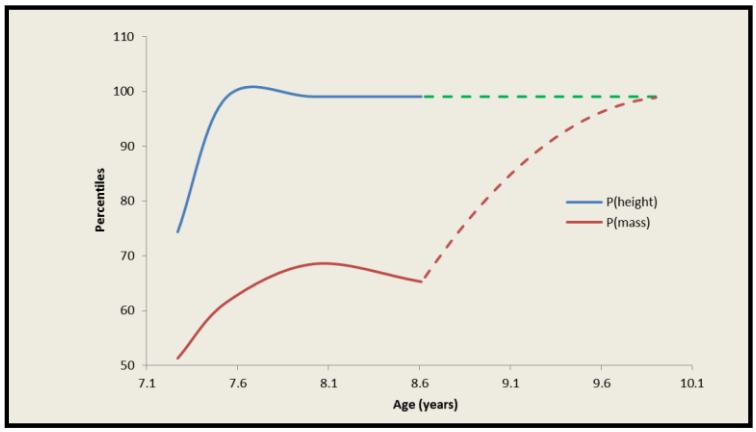
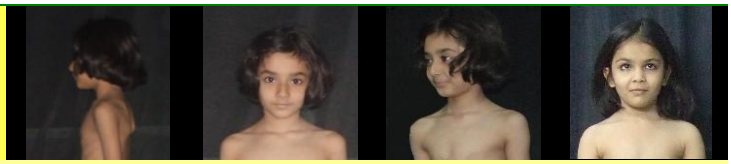


Figure AFIII-1: Time evolution of L. G.'s height and mass percentiles for her four checkups in the age range 7.27-8.61 *years* (navigational trajectory: solid curve), including the desired course-of-action (guidance trajectory: green-dashed line) and recommended intervention (control action: none for height-percentile curve and maroon-dashed for mass-percentile curve)

Table-AFIII-2c: Growth-and-Obesity Vector-Roadmap of L. G.

Checkup	*1st*	*2nd*	*3rd*	*4th*
Photograph				
Scanned Signatures	*LG*	*LG*	*LG*	*LG*
Class and Section	II-B	II-B	III-B	III-B
Date of Checkup (*year-month-day*)	2014-11-22	2015-02-28	2015-08-22	2016-03-26
Age (*year-month-day*)	07-03-07	07-05-23	08-00-07	08-07-11
Age (*decimal years*)	7.27	7.54	8.02	8.61
Dress Code	0/0.5	0/0.5	0/0.5	0/0.5
Behavior Code	0	0	0	0
Height, *h* (*cm*) ⇐	126.96	139.92	143.51	147.255
Height (*ft-in*)	4 *ft* 1.98 *in*	4 *ft* 7.09 *in*	4 *ft* 8.50 *in*	4 *ft* 9.97 *in*
Percentile-of-Height, *P*(*h*) ⇔	74.37	99.01	99.06	99.06
Current-Age-Army-Cutoff (CA-AC) Height (*cm*) ⇐	118.26	119.86	122.53	125.56
Δ Height *w. r. t.* CA-AC Height (*cm*)	+8.70	+20.06	+20.98	+21.70
Current-Age-Mid-Parental (CA-MP) Height (*cm*) ⇐	118.00	119.59	122.25	125.27
Δ Height *w. r. t.* CA-MP Height (*cm*)	+8.96	+20.33	+21.26	+21.99
Reference Height (*cm*) ⇐	126.96	139.92	143.51	147.255
Percentile-of-Reference-Height ⇔	74.37	99.01	99.06	99.06
Estimated-Adult Height (*cm*)	167.59	180.04	180.44	180.42
Estimated-Adult Height (*ft–in*)	**5 *ft* 5.98 *in***	**5 *ft* 10.88 *in***	**5 *ft* 11.04 *in***	**5 *ft* 11.03 *in***
Algebraic Status (pertaining-to-height), $STATUS_{\pm}(h)$	+7.59%	+17.00%	+17.39%	+17.55%
Qualitative Status (pertaining-to-height)	**1st-Deg Tall**	**2nd-Deg Tall**	**2nd-Deg Tall**	**2nd-Deg Tall**
Gross Mass (*kg*)	23.66	25.69	28.21	29.975
Clothing Correction (*kg*)	0	0	0	0
Net Mass, μ (*kg*) ⇒	23.66	25.69	28.21	29.975
Net Weight (*lb-oz*)	52 *lb* 2.72 *oz*	56 *lb* 10.34 *oz*	62 *lb* 3.25 *oz*	66 *lb* 1.52 *oz*
Percentile-of-Net-Mass, $P(\mu)$ ⇔	51.31	61.58	68.54	65.29
Optimal Mass (*kg*) ⇒	26.37	39.12	42.61	46.75
Δ Mass-for-Height (*kg*)	–2.71	–13.43	–14.40	–16.77
Estimated-Adult Mass (*kg*)	58.62	61.76	63.88	62.89
Estimated-Adult Weight (*lb–oz*)	129 *lb* 4.04 *oz*	136 *lb* 2.73 *oz*	140 *lb* 13.64 *oz*	138 *lb* 10.62 *oz*
Algebraic Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	–10.28%	–34.33%	–33.80%	–35.88%
Qualitative Status (pertaining-to-mass)	**2nd-Deg Wasted**	**4th-Deg Wasted**	**4th-Deg Wasted**	**4th-Deg Wasted**
Cumulative-Scoliosis-Risk Weightage (CSRW)	8.50	9.00	9.00	9.50
Estimated-Adult *BMI* (kg/m^2)	20.87	19.05	19.62	19.32
Nutritional Status	**EC I**	**EC I**	**EC I**	**EC I**
$P(h) + P(\mu)$	125.68	160.60	167.59	164.34
Build	**Medium**	**Big**	**Big**	**Big**

Need to take care of the checked items for L. G.**:**

⊗ 1. Optimal-weight management advised — note (*d*) on page-1 footer **(pseudo-gain of mass: physical gain**

O 2. Your child seems not to gain height, optimally — note (*g*) on page-1 footer **with percentile drop)**

⊗ 3. Guard against your child acquiring scoliosis — notes (*i*, *j*) on page-1 footer **(CSRW increased to 9.50)**

O 4. Signs of anemia observed; your child may have vitamin-D deficiency — note (*h*) on page-1 footer

Table-AFIII-3*a*: Month-wise mass (weight) management for parents

Father's Date of Birth: ♀ July15, 1971 • *Mother's Date of Birth*: ♀ January 2, 1979

Target Date	*Father* ♀		*Mother* ♀	
	kg	*lb-oz*	*kg*	*lb-oz*
November 22, 2014	**62.66**	**138 *lb* 2.64 *oz***	**71.16**	**156 *lb* 14.52 *oz***
December 22, 2014	63.39	139 *lb* 12.40 *oz*	70.39	155 *lb* 3.36 *oz*
January 22, 2015	64.12	141 *lb* 6.15 *oz*	69.62	153 *lb* 8.19 *oz*
February 22, 2015	64.85	142 *lb* 15.91 *oz*	68.85	151 *lb* 13.03 *oz*
March 22, 2015	65.58	144 *lb* 9.66 *oz*	68.08	150 *lb* 1.86 *oz*
April 22, 2015	66.32	146 *lb* 3.77 *oz*	67.32	148 *lb* 7.05 *oz*
May 22, 2015	67.06	147 *lb* 13.88 *oz*	66.56	146 *lb* 12.24 *oz*

Table-AFIII-3*b*: Lifestyle adjustment, diet and exercise plans for parents to achieve month-wise targets

	Father ♀	*Mother* ♀
Lifestyle Adjustment	Active and carefree lifestyle, lesser screen time, outdoor activities combined with light reading and social interactions, 6-hour night-time sound sleep	
Diet Plans	3 relaxed and balanced meals, 10-12 glasses of water daily — absolutely NO carbonated drinks	
	To put on mass (weight), diet plan should include milk, potato items (baked or boiled, but not fried) and protein-rich diet	To shed off mass (weight), diet plan should include salad, yogurt and skimmed milk
Exercise Plans	Guarded-graduated exercises preceded by warm-up and followed by cool-down routines	
	To put on mass (weight), father should perform heavy exercises for shorter duration, consistently	To shed off mass (weight), mother should perform light exercises longer duration, consistently

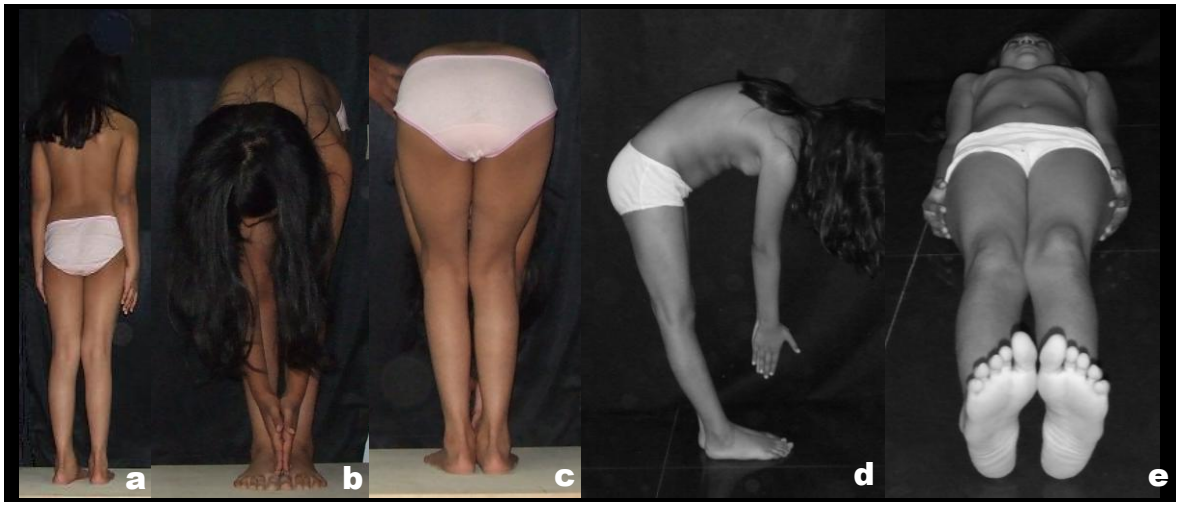
Table-AFIII-3*c*: Obesity Roadmaps of parents

	Father ♀	*Mother* ♀
Date of Checkup (*year-month-day*)	2014-11-22	2014-11-22
Age (*year-month-day*)	43-04-07	35-10-20
Age (*decimal years*)	43.36	35.89
Dress Code	1.5/2	2/2
Height, *h* (*cm*)	167.16	160.16
Height (*ft-in*)	5 *ft* 5.81 *in*	5 *ft* 3.06 *in*
Gross Mass (*kg*)	62.96	71.46
Clothing Correction (*kg*)	0.30	0.30
Net Mass, μ (*kg*)	62.66	71.16
Net Weight (*lb-oz*)	138 *lb* 2.64 *oz*	156 *lb* 14.52 *oz*
Optimal Mass (*kg*)	67.06	66.56
Δ Mass-for-Height (*kg*)	–4.40	+4.60
Algebraic Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	–6.56%	+6.91%
Qualitative Status (pertaining-to-mass)	**1st-Deg Wasted**	**1st-Deg Obese**
Body-Mass Index, *BMI* (kg/m^2)	22.42	27.74
$P(h) + P(\mu)$	31.45	118.16
Build	**Small**	**Medium**

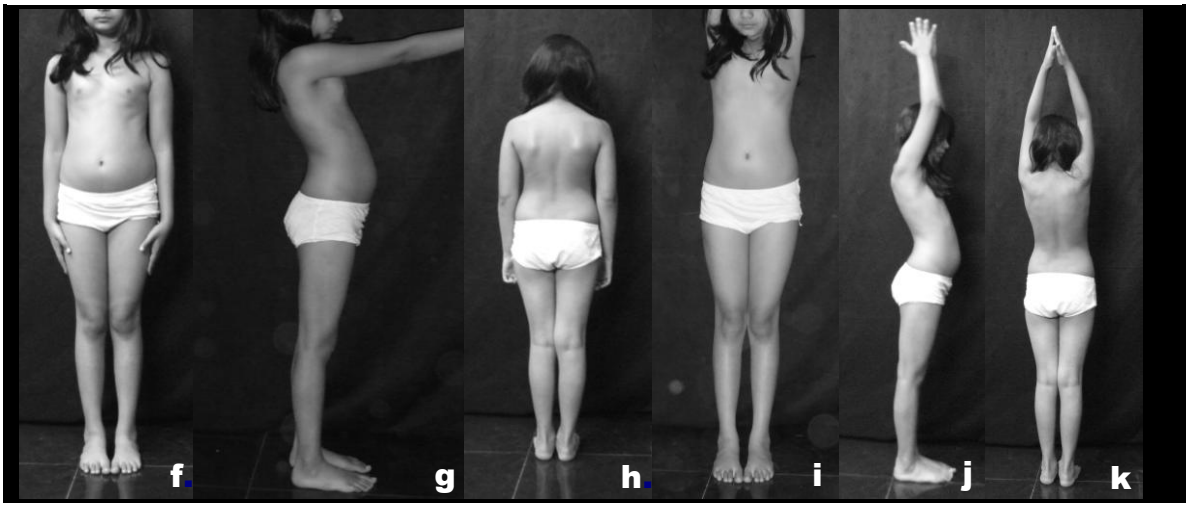
HISTORY AND PHYSICAL EXAMINATION of L. G.

L. G.: Female, 7+ at the first checkup, biological child
Family History: Non-cousin marriage, blood group B+ of father and mother, both parents working, graduates in medical science, father has cardiac problems, mother diabetic and has congenital optic nerve weakness
Pregnancy, Delivery and Neonatal: Pregnancy normal, cesarean delivery after 36 weeks of pregnancy, birth length 41.65 *cm*, birth mass 3.5 *kg*, blood group B+, jaundice at birth, weaning mode — bottle
Sleep Pattern and Diet Habits: 9-10 hour sleep, 3 balanced meals, 2 balanced snacks (both parents studied nutrition in undergraduate work)
Academics and Social Interaction: Reserved, independent, bold, academically doing well, behavior in lab good, quiet, coöperative, tried to replicate anthropometric techniques on father
Sports and Co-Curricular Activities: Racing, gymnastics, dancing and music
Physical Examination: L. G. was examined completely undressed wearing only panties (barefoot, stripped-to-waist) to thoroughly check nutritional status, posture, gait and presence of trunk deformities (scoliosis, kyphosis and lordosis). Visual, forward bending and moiré examinations of the spinal column were performed, lips bluish, teeth rough on edges, nails whitish with white spots, toes converging observed in gait away and towards, midline of back S shaped, shoulders, scapulae and spinal dimples uneven, body triangles not equal and plumb-line not aligned, front and back, not able to touch toes

CLINICAL PHOTOGRAPHS OF L. G.



FiguresAFIII-2*a*-*e*: Posture and forward bending photographs of L. G.: (*a*) posture of back; (*b*)-(*d*) forward-bending tests; (*e*) posture with the child supine — (*a*)-(*c*) taken on November 22, 2014; (*d*), (*e*) on March 26, 2016



FiguresAFIII-2*f*-*k*: Posture (*f*)-(*h*) and mild stretching (*i*)-(*k*) photographs of L. G. taken on March 26, 2016

COLOR-CODING FOR VARIOUS TABLES

Table-AFIII-4*a*: Row separation in Tables-AFIII-1*a*-3*a*

White	**Hue** **Sat** **Lum**	**170 255** **000 255** **255 255**	**Red** **Green** **Blue**
Grey	**Hue** **Sat** **Lum**	**170 230** **000 230** **230 230**	**Red** **Green** **Blue**

Table-AFIII-4*b*: Row separation in Tables-AFIII-2*b* and -3*b*

Lifestyle Adjustment	**Hue** **Sat** **Lum**	**021 255** **255 204** **204 153**	**Red** **Green** **Blue**
Diet Plan	**Hue** **Sat** **Lum**	**234 255** **255 153** **204 204**	**Red** **Green** **Blue**
Exercise Plan	**Hue** **Sat** **Lum**	**127 204** **255 255** **230 255**	**Red** **Green** **Blue**

Table-AFIII-4*c*: Row separation in Tables-AFIII-2*c* and -3*c*

Blue arrows point to color scheme used in table inserted in journal paper (without row separation)

Vital Statistics			
Light	**Hue** **Sat** **Lum**	**042 255** **255 255** **204 153**	**Red** **Green** **Blue**
Dark	**Hue** **Sat** **Lum**	**042 255** **255 255** **169 083**	**Red** **Green** **Blue**
Height Data			
Light	**Hue** **Sat** **Lum**	**149 189** **255 222** **222 255**	**Red** **Green** **Blue**
Dark	**Hue** **Sat** **Lum**	**149 153** **255 204** **204 255**	**Red** **Green** **Blue**
Mass Data			
Light	**Hue** **Sat** **Lum**	**234 255** **255 153** **204 204**	**Red** **Green** **Blue**
Dark	**Hue** **Sat** **Lum**	**234 255** **255 117** **186 186**	**Red** **Green** **Blue**
Combined Data			
Light	**Hue** **Sat** **Lum**	**085 204** **255 255** **230 204**	**Red** **Green** **Blue**
Dark	**Hue** **Sat** **Lum**	**085 129** **255 255** **192 129**	**Red** **Green** **Blue**

Table-AFIII-5*a*: Status (pertaining-to-height) — qualitative and algebraic

4th-Degree Tall	**Hue** **Sat** **Lum**	**000 255** **255 000** **128 000**	Red Green Blue	$STATUS_{\pm}(h) \geq +30\%$
3rd-Degree Tall	**Hue** **Sat** **Lum**	**019 227** **233 108** **119 010**	**Red** **Green** **Blue**	$+20\% \leq STATUS_{\pm}(h) < +30\%$
2nd-Degree Tall	**Hue** **Sat** **Lum**	**032 255** **255 192** **128 000**	**Red** **Green** **Blue**	$+10\% \leq STATUS_{\pm}(h) < +20\%$
1st-Degree Tall	**Hue** **Sat** **Lum**	**042 255** **255 255** **128 000**	**Red** **Green** **Blue**	$+1\% \leq STATUS_{\pm}(h) < +10\%$
Normal	**Hue** **Sat** **Lum**	**104 000** **255 176** **088 080**	**Red** **Green** **Blue**	$-1\% \leq STATUS_{\pm}(h) < +1\%$
1st-Degree Stunted	**Hue** **Sat** **Lum**	**042 255** **255 255** **128 000**	**Red** **Green** **Blue**	$-10\% \leq STATUS_{\pm}(h) < -1\%$
2nd-Degree Stunted	**Hue** **Sat** **Lum**	**032 255** **255 192** **128 000**	**Red** **Green** **Blue**	$-20\% \leq STATUS_{\pm}(h) < -10\%$
3rd-Degree Stunted	**Hue** **Sat** **Lum**	**019 227** **233 108** **119 010**	**Red** **Green** **Blue**	$-30\% \leq STATUS_{\pm}(h) < -20\%$
4th-Degree Stunted	**Hue** **Sat** **Lum**	**000 255** **255 000** **128 000**	**Red** **Green** **Blue**	$STATUS_{\pm}(h) < -30$

Table-AFIII-5*b*: Status (pertaining-to-mass) — qualitative and algebraic

4th-Degree Obese	**Hue** **Sat** **Lum**	**000 255** **255 000** **128 000**	Red Green Blue	$STATUS_{\pm}(\mu) \geq +30\%$
3rd-Degree Obese	**Hue** **Sat** **Lum**	**019 227** **233 108** **119 010**	**Red** **Green** **Blue**	$+20\% \leq STATUS_{\pm}(\mu) < +30\%$
2nd-Degree Obese	**Hue** **Sat** **Lum**	**032 255** **255 192** **128 000**	**Red** **Green** **Blue**	$+10\% \leq STATUS_{\pm}(\mu) < +20\%$
1st-Degree Obese	**Hue** **Sat** **Lum**	**042 255** **255 255** **128 000**	**Red** **Green** **Blue**	$+1\% \leq STATUS_{\pm}(\mu) < +10\%$
Normal	**Hue** **Sat** **Lum**	**104 000** **255 176** **088 080**	**Red** **Green** **Blue**	$-1\% \leq STATUS_{\pm}(\mu) < +1\%$
1st-Degree Wasted	**Hue** **Sat** **Lum**	**104 000** **255 176** **088 080**	**Red** **Green** **Blue**	$-10\% \leq STATUS_{\pm}(\mu) < -1\%$
2nd-Degree Wasted	**Hue** **Sat** **Lum**	**032 255** **255 192** **128 000**	**Red** **Green** **Blue**	$-20\% \leq STATUS_{\pm}(\mu) < -10\%$
3rd-Degree Wasted	**Hue** **Sat** **Lum**	**019 227** **233 108** **119 010**	**Red** **Green** **Blue**	$-30\% \leq STATUS_{\pm}(\mu) < -20\%$
4th-Degree Wasted	**Hue** **Sat** **Lum**	**000 255** **255 000** **128 000**	**Red** **Green** **Blue**	$STATUS_{\pm}(\mu) < -30$

Figure-AFIII-3*a*: Coördinate-plane representation of nutritional status — acute malnutrition is the limiting situation of under-nutrition; energy-channelization III (puberty-induced energy-channelization) is the limiting case of over-nutrition

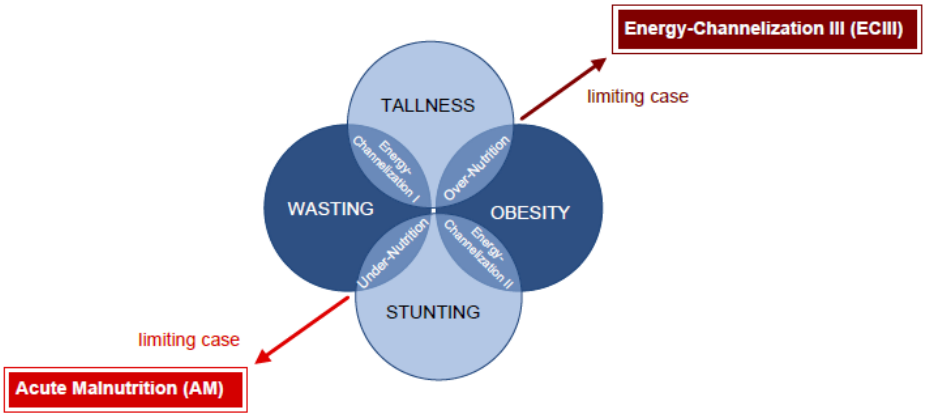


Figure-AFIII-3*b*: Venn-diagrammic representation of nutritional status

Table-AFIII-6*a*: Month-wise height and mass management in scalar-roadmap

Scalar Model: http://www.ngds-ku.org/Presentations/Vector/Additional_File_1.pdf

Hue	000 128	Red
Sat	255 000	Green
Lum	064 000	Blue

Table-AFIII-6*b*: Estimated-adult height

<: Lesser than Army-Cutoff Height • >: In Excess of Army-Cutoff Height

Army-Cutoff Height for the Pakistani Youth: 5 *feet* 4 *inches* for males and 5 *feet* 2 *inches* for females

<	Hue	000 255	Red
	Sat	255 000	Green
	Lum	128 000	Blue
>	Hue	106 051	Red
	Sat	128 153	Green
	Lum	102 102	Blue

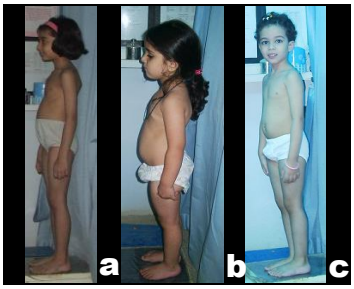
Table-AFIII-6*c*: Severity of acute malnutrition (where present)

Example: https://www.ngds-ku.org/Papers/J40.pdf

Hue	000 255	Red
Sat	255 000	Green
Lum	128 000	Blue

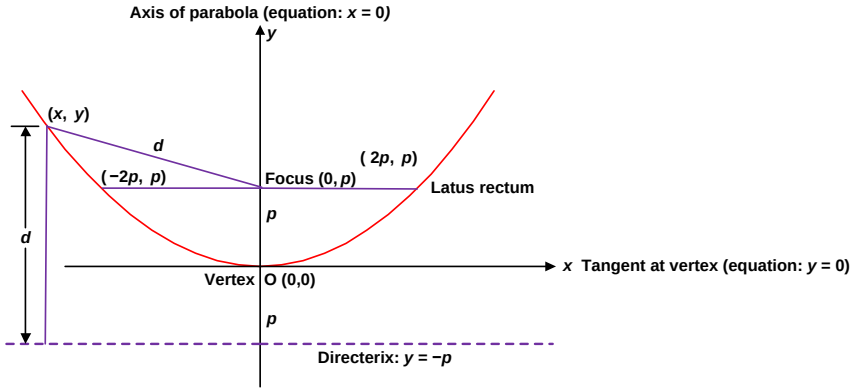
Table-AFIII-6*d*: Classification of build

Small	Hue	000 255	Red
	Sat	255 000	Green
	Lum	128 000	Blue
Medium	Hue	104 000	Red
	Sat	255 176	Green
	Lum	088 080	Blue
Big	Hue	042 255	Red
	Sat	255 255	Green
	Lum	128 000	Blue



Figures-AFIII-4*a*-*b*: Examples of children of different builds — (*a*) small, (*b*) medium and (*c*) big

DERIVATION OF EQUATION OF PARABOLA



FigureAFIII-5: Drawing used to derive equation of parabola
Source: https://www.intmath.com

The parabola is defined as the curve generated from the locus of a point, which moves in such a manner so that it remains, always, at the same distance from a fixed point (termed as 'focus') and a given line (termed as 'directrix'). 'Latus rectum' is the line segment parallel to directrix passing through focus with end points on the parabolic curve. 'Axis of symmetry' (also called 'axis of parabola') is the line normal to directrix passing through focus. To derive equation of a parabola opening on top, whose vertex lies at the origin (0, 0) with y axis (equation: $x = 0$) as axis of symmetry[§], take $(0, p)$ be the coödinates of focus. The equation of directrix may be written as $y = -p$. If (x, y) is a point on the curve, then applying distance formula (derived using Pythagoras theorem), one gets

$$\sqrt{(x-0)^2 + (y-p)^2} = y + p$$

Squaring both sides and simplifying one gets

$$x^2 = 4py$$

which is the equation of parabola. The latus rectum is part of the line $y = p$. Substituting this value of y in the above equation and solving for x, one gets 2 values, $-2p$ and $+2p$. Hence the end points of line segment, which constitute latus rectum, come out to be $(-2p, p)$ and $(2p, p)$. Therefore, length of latus rectum is $4p$. The x-axis (equation: $y = 0$) is tangent to parabola at the vertex, which could, also, be visualized as perpendicular bisector of line segment, which has end points as focus and intersection of symmetry axis and directrix. If the vertex is translated (shifted) to (x_0, y_0), the equation of parabola becomes

$$(x - x_0)^2 = 4p(y - y_0)$$

The equation of directrix, then, becomes $y = y_0 - p$, the equation of axis of symmetry, $x = x_0$, equation of tangent to parabola, $y = y_0$, the coördinates of focus take the shape $(x_0, y_0 + p)$ and the end points of latus rectum could be expressed as $(x_0 - 2p, y_0 + p)$ and $(x_0 + 2p, y_0 + p)$. Length of latus rectum remains unchanged.

[§]which means that for every point (x, y) on the parabola, there exists a mirror point $(-x, y)$ on the parabolic curve

DESIRED TRAJECTORIES FOR HEIGHT AND MASS PERCENTILES

Table-AFIII-7*a*: Percentile of height, *h*, as a function of age, *A*

$$P(h, A) = 99.0559863$$

. **Table-AFIII-7*b*: Percentile of mass, μ, as a function of age, *A***

$$P(\mu, A) = 99.0559863 - 17.5557474(A - 10)^2$$

Table-AFIII-7*c*: Percentiles of height and mass on the dates, for which recommendations are generated

Date of Last (Fourth) Checkup: March 26, 2016 • *Decimal Age*, $A_0^{\P}$ = 8.613054869 *years*
$P_{ref}^{\P}$ = 99.0559863 • $P(h, A_0)^{\P}$ = 99.0559863 • $P(\mu, A_0)^{\P}$ = 65.28545564

Dates of Recommendation	*Decimal Age*, A_i (*years*)	$P(h, A_i)$	$P(\mu, A_i)$
April 26, 2016	8.697754	99.0559863	69.28418086
May 26, 2016	8.779722	99.0559863	72.91408222
June 26, 2016	8.864421	99.0559863	76.41715328
July 26, 2016	8.946388	99.0559863	79.56738940
August 26, 2016	9.031088	99.0559863	82.57480639
September 26, 2016	9.115787	99.0559863	85.33033360

$^{\P}A_0$ is the reference age, when control action is initiated; $P(h, A_0)$ represents percentile of height at the most-recent checkup, taken as reference; $P(\mu, A_0)$ represents percentile of mass at the most-recent checkup, taken as reference; P_{ref} is the reference percentile obtained by selecting maximum value of percentile of current height, $P(h, A_0)$, percentile of army-cutoff height, P_{AC}, and percentile of mid-parental height, P_{MP}.

Web address of the main document (*first author's homepage*): **GROWTH-AND-OBESITY VECTOR-ROADMAPS OF THE PAKISTANI CHILDREN** https://www.ngds-ku.org/Papers/J43.pdf

Web address of this document (*first author's homepage*): **Additional File 3 — GROWTH-AND-OBESITY VECTOR-ROAFMAPS OF G. FAMILY** https://www.ngds-ku.org/Papers/J43/Additional_File_3.pdf


Computation of Adult Height
According to Dr. Maureen Morris
Boy's Adult Height
= (F + M + 13)/2
Girl's Adult Height
= (F + M - 13)/2
All measurements are in cm
F = Biological Father's Height
M = Biological Mother's Height
Both have an error bar of 13 cm
Growth Charts: Girls
Categories of Short Stature
Familial
Hormonal
IUGR
Psychosocial
Chromosomal/genetic
Constitutional delay or "late bloomer"
Chronic disease
There could also be Disproportionate Short Stature
Cardiac
Respiratory
Renal
Nutrition
Malabsorption
Diagnostic Tools
GHD, Height Velocity, Bone Age
Growth Retardation: Implications for Society
Research involving Minors
Software Dev