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OPTIMAL-MASS MANAGEMENT IN OBESE CHILDREN¶

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ABSTRACT

This paper proposes an objective criterion for shedding off or putting on mass (weight) in marginally obese children. With increasing awareness of childhood obesity among community-health workers, pediatricians, nutritionists, teachers and parents, efforts are made to reduce mass based on the current obesity profile of a child. However, this approach fails to take into account the fact that a child, by the very nature of age group under study, is gaining height at the same time trying to manage mass through a combination of diet, exercise and lifestyle adjustment (optimization approach). Optimal mass was defined in 2011 by the author as the mass corresponding to percentile of height. Hence, a child should momentarily achieve optimal mass when mass-percentile trajectory crosses height-percentile trajectory. However, for the purpose of maintaining optimal mass, not only, the values, but also, the slopes of height- and mass-percentile trajectories must match (dynamical-system approach). This paper follows height and mass trajectories of a girl in the age range 5.88-9.44 *years* and illustrates the need for gaining mass instead of reducing, although she was marginally obese at her last checkup. To help achieve the goal of optimal-mass management, month-wise targets to attain specific heights and masses (on specific dates of a given month) as well as lifestyle adjustment, diet and exercise plans are provided.

Keywords: Growth-and-Obesity Roadmap, body-mass index, *estimated-adult BMI*, month-wise recommendations, diet and exercise plans

LIST OF ABBREVIATIONS

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

BMI: **B**ody-**M**ass **I**ndex
MP: **M**id-**P**arental
NGDS: **N**ational **G**rowth and **D**evelopmental **S**tandards for the Pakistani Children
SF: The **S**yed **F**irdous Growth-and-Imaging Laboratory, University of Karachi
SGPP: **S**ibling **G**rowth **P**ilot **P**roject — a subproject of the NGDS Pilot Project

INTRODUCTION

Children are assets of Pakistan. In today's competitive world, children would excel in practical life if they have a healthy body along with an educated mind. An obese individual shall have a lower probability of getting a high-profile job as compared to a slim, a smart and a sharp candidate. Doctors recommend that risks of diabetes and heart diseases could be minimized if height and mass (weight) monitoring is started around the age of five (Baker *et al.*, 2007).

Obesity is becoming a problem worldwide among children and adolescents (Ng *et al.*, 2014; Ogden *et al.*, 2014). The incidence of childhood obesity has increased all over the world (Silventoinen *et al.*, 2010). Socioeconomic disparities may, also, be a contributing factor in this trend (Stamatakis *et al.*, 2010). A number of complications in adulthood may be related to childhood obesity (Bibbins-Domingo *et al.*, 2007), in particular, adult cardiovascular disease (Lloyd *et al.*, 2010). Obesity in children may be linked to serious psychological, physical and social consequences (Odds *et al.*, 2010) resulting in impaired economic, educational and social productivity (Tathiah *et al.*, 2013).

Childhood obesity is contributing significantly to adult obesity, diabetes as well as non-communicable diseases (Black *et al.*, 2013). Hence, it is imperative to detect the problem at an early stage to plan and implement efficient and effective intervention strategies (Ludwig, 2007). However, this over-consciousness of issue at times results in requiring a slightly obese child to lose mass (weight) on the basis of current obesity profile. Since a child is, also, gaining height in addition to mass, this action makes the child wasted over a period of time.

This paper illustrates the issue by presenting the case of a girl for her 5 checkups. Although she was classified as obese at her last 2 checkups, she was advised to gain mass to keep up with recommended height gain based on target (adult-mid-parental) height. To achieve these goals, targets (month-wise) to possess specific heights and masses (weights), on particular dates of a certain month, as well as lifestyle adjustment, exercise and diet plans are provided.

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

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MATERIAL AND METHODS

Project Protocols

In 1998, the NGDS (National Growth and Developmental Standards for the Pakistani Children) Pilot Project (http://ngds.uok.edu.pk) was initiated after 'Institutional Review Process', incorporating ethical and human-right standards (opt-in policy) applicable in this region (Kamal *et al.*, 2002; 2004). Four representative schools (one civilian and one each serving the families of servicemen belonging to Pakistan Army, Pakistan Air Force and Pakistan Navy) were included in this study. A subproject of the NGDS Pilot Project, named as SGPP (Sibling Growth Pilot Project), served local families, who reported to SF-Growth-and-Imaging Laboratory along with their 5-10-*year*-old children, for detailed checkups (http://www.ngds-ku.org/ngds_URL/subprojects.htm#SGPP). Measurements were carried out giving due regard to comfort, confidentiality, dignity, privacy and safety of participants.

Laboratory Techniques

Laboratory techniques employed for data collection are described, briefly. Detailed protocols are available, elsewhere (Kamal, 2006). Boys and girls were screened for factors, which may be responsible for growth retardation, including anemia, cardiac disease and spinal deformities, in particular, kyphosis, lordosis and scoliosis (Kamal *et al.*, 2015*a*). In addition, knees joining (static exam) and knees knocking (dynamic exam) were checked and gaits were observed both from front and back to look for toes outward, toes inward as well as limp or spastic gait.

Heights and masses were measured by reproducible anthropometrists to least counts of 0.1 *cm* (1998-2011, setsquares and wall-mounted engineering-tape); 0.01 *cm* (2012 onward, modified setsquares and wall-mounted engineering-tape) and 0.5 *kg* (1998-2011, bathroom scale); 0.01 *kg* (2012 onward, modified set-squares and improvised beam scale), respectively, before noon, as children were 1-1.5 *cm* taller in the morning as compared to the afternoon. Parents were measured wearing minimal indoor clothing and children were required to undress completely except short underpants. Everyone took off shoes and socks as well as accessories for measurements. A suitable clothing correction was taken off from 'gross mass' (mass obtained in indoor clothing) to compute 'net mass' (mass with no clothing on), μ, for mother and father. Children were measured wearing only underwear, all clothing above the waist removed, barefoot. Their recorded masses were used without any clothing correction as they were very close to net masses.

For measuring height (stature), h, subject was told to stand touching the engineering tape (mounted on wall, vertical alignment checked through plumb line) and instructed to align hands with body, palms touching thighs and heels together. Height was measured, when the incumbent fully inhaled so that the incumbent's chest was expanded and tummy was in (attention position). The anthropometrist held a pencil at eye level to make sure that chin of the subject was parallel to floor. For measuring mass (weight), the subject stood in center of beam scale, palms on thighs and feet separated, looking straight and breathed in to trap maximum air (stand-at-ease position). A standard 100-*cm* ruler and a standard 2-*kg* mass were used to calibrate height- and mass-measurement instruments at the beginning of each daily session along with noting down of zero errors.

Undressing of children helped anthropometrists to ascertain standard posture during measurements, making sure that knees were not flexed and toes not lifted. The measurers were able to verify that the measurements were performed while the child properly inhaled before recording, as height and mass values differed slightly between complete inhalation and complete exhalation. Further, the examiners were able to better determine malnutrition and spinal deformities in the stripped children.

Growth-and-Obesity Roadmaps

Data were processed using model developed by our group (Kamal *et al.*, 2015*c*), a generalization of earlier models (Kamal *et al.*, 2011; Kamal and Jamil, 2012). Following are the salient features**:**

a) The model and the associated software took as input, parents' heights, child's gender, birth date, checkup date, height and mass to generate target height, height and mass percentiles, body-mass index (*BMI*), *estimated-adult BMI*, optimal mass, statuses expressing degrees of obesity/wasting and tallness/stunting as well as month-wise recommendations to manage height and mass (specific targets on given dates).

b) *BMI* was calculated by dividing mass in *kilograms* with square of height in *meters*. Introduced by Adolphe Quetelet in 1832 (called 'Quetelet index' by contemporaries) and renamed body-mass index by Ancel Keys in 1972; merits, demerits and history of this index are given elsewhere (Kamal and Jamil, 2014).

c) *Estimated-adult BMI* was computed by replacing estimated-adult values (computed at the age of 20 *years*) with the current values of mass corresponding to percentile of height. This gives snapshot of obesity status, when the child turns into an adult (Kamal and Jamil, 2012).

Table 1. Nutritional-status classification

Classification	*Description*	$STATUS_{\pm}(h)$	$STATUS_{\pm}(\mu)$
Energy-Channelization I	Tallness + Wasting	Positive	Negative
Under-Nutrition	Stunting + Wasting	Negative	Negative
Energy-Channelization II	Stunting + Obesity	Negative	Positive
Over-Nutrition	Tallness + Obesity	Positive	Positive

d) Optimal mass (for persons below the age of 30 *years*) was defined as the mass corresponding to percentile of height (Kamal *et al.*, 2011), which was considered as the reference mass to be achieved (of course, not using the current value but the value 6 *month* down the road). For persons above the age of 30 *years*, refer to next section for definition of optimal mass.

e) Nutritional status was determined by examining signs of algebraic status (pertaining-to-height), $STATUS_{\pm}(h)$, and algebraic status (pertaining-to-mass), $STATUS_{\pm}(\mu)$. Table 1 lists criteria for classification (Kamal *et al.*, 2015*a*).

f) Built of child (given consideration in forming sport teams) was obtained by summing percentiles of height, $P(h)$, and mass, $P(\mu)$, a value of $P(h)+P(\mu)$ less than 50 represents 'small' built (brain functions dominate body functions — generally good at intellectual work as well as planning and development tasks), whereas a value of $P(h)+P(\mu)$ equal to or mare than 50 but less than 150 indicates 'medium' built (brain and body functions are equally dominating — could be trained to do intellectual work or tasks involving strength and speed). Finally, a value of $P(h)+P(\mu)$ above 150 suggests 'big' built (body functions dominate brain functions — suitable for tasks involving strength and speed). Details are given elsewhere (Kamal and Khan, 2015).

g) The percentile of reference height, P_{ref}, used to generate month-wise recommendations to gain height and put on/shed off mass (weight), was chosen as maximum of 3 percentiles — $P(h)$, percentile of current height; P_{MP}, percentile of mid-parental height; $P_{\text{army-cutoff}}$, percentile of army-cutoff height (Kamal *et al.*, 2015*b*). Mathematically, $P_{\text{ref}} = max(P(h), P_{\text{army-cutoff}}, P_{\text{MP}})$

h) The above percentiles corresponded to estimated-adult, target (adult-mid-parental) and army-cutoff heights, respectively (Table 2).

i) For a girl, target height was evaluated by subtracting 6.5 *cm* from average heights (in *cm*) of father and mother and army-cutoff height (for induction into the Armed Forces of Pakistan) is fixed at 5 *ft* 2 *in* (157.48 *cm*), corresponding to 19^{th} (19.36 to be exact) percentile.

j) Month-wise recommendations were prepared to pick up height (in both *centimeters* and *inches*) and gain/lose mass (in *kilograms*), corresponding to weight (in *pounds* and ounces).

k) In a separate table, recommendations to achieve certain values of height and mass (weight), were listed for a given date (the date in the month of most-rent checkup) of each month (for 6 *months* following month of checkup).

l) Guidelines made available for lifestyle adjustment, diet and exercise plans to achieve the above quantitative objectives.

Growth-and-Obesity Roadmap of a Marginally Obese Girl

Z. H. Z., female, was enrolled in our growth-and-obesity monitoring program through the NGDS Pilot Project after 'The Informed Consent Form' (http://www.ngds-ku.org/ngds_folder/Protocols/NGDS_form.pdf) was received duly signed by both parents, allowing measurements to be performed on the school premises. For checkups in SF-Growth-

Table 2. Heights important for a child's growth and professional career

Nomenclature	*Depends on Child's Height*	*Depends on Parents' Heights*	*Based on Country-Wide Standards*	*Corresponding Percentile*
Estimated-Adult Height	Yes	No	No	$P(h)$
Target (Adult-Mid-Parental) Height	No	Yes	No	P_{MP}
Army-Cutoff Height	No	No	Yes	$P_{\text{army-cutoff}}$

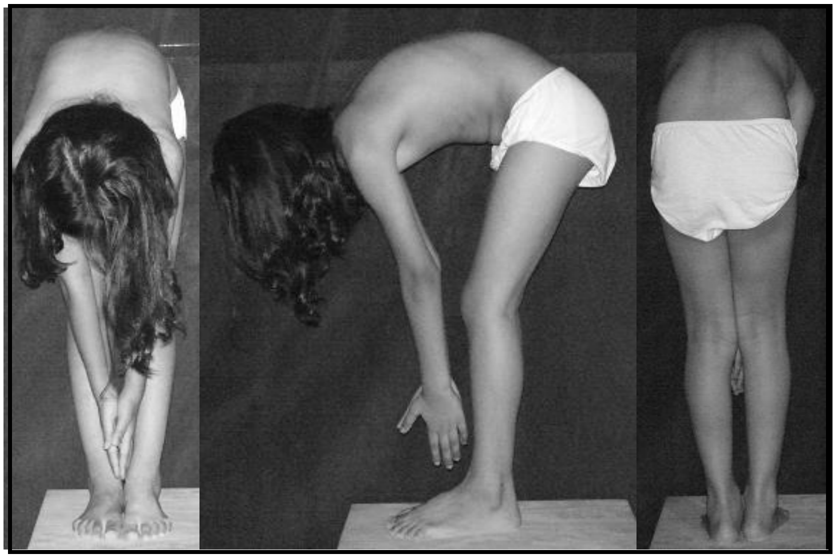


Fig. 1*a-c*. Forward-bending test of Z. H. Z. conducted on May 13, 2012. Left side elevated, when the child was facing the examiner — lumbar-region asymmetry (*a*) and right side elevated, when child's back was towards the examiner — lumbar-region asymmetry (*c*); raising strong suspicion of S curve

and-Imaging Laboratory, the parents filled out and put their signatures on 'The SGPP Participation Form' (http://www.ngds-ku.org/SGPP/SGPP_form.pdf).

Z. H. Z. is an only child living with biological parents. After a normal pregnancy of 9 *months*, she was born on June 16, 2005 through cesarean section (birth weight 7 *lb*; blood group B+). When 9-*month* old, she had sore throat and measles. She suffered from jaundice at 6 *years* of age. Her daily routine consists of 3 meals and 1 snack, all relaxed, screen time 2-3 *hours* (mostly TV, rarely computer) and sound sleep of 8-9 *hours*. She is active in co-curricular activities and sports. At times, she becomes irritative during interaction with family. Overall, she is independent and bold. Her 1st checkup was conducted on May 4, 2011 (age 5 *years* 10 *months* 8 *days*) with regular follow-ups. Her 5th and the most-recent checkup took place on November 23, 2014 (age 9 *years* 5 *months* 7 *days*). All of her checkups were conducted with the child barefoot and completely undressed except panties. She was relaxed and coöperative during every checkup. Adam's forward bending test was positive in the last 4 checkups, (Figures 1*a-c*). However, moiré fringe topography (identifies at-risk cases of scoliosis) was negative. Figures 2*a-f* show posture and moiré photographs of Z. H. Z. Figures 1*a-c* first appeared in (Kamal *et al.*, 2015*a*) and Figure 2*e* in (Kamal and Jamil, 2014), both of them published in this journal.

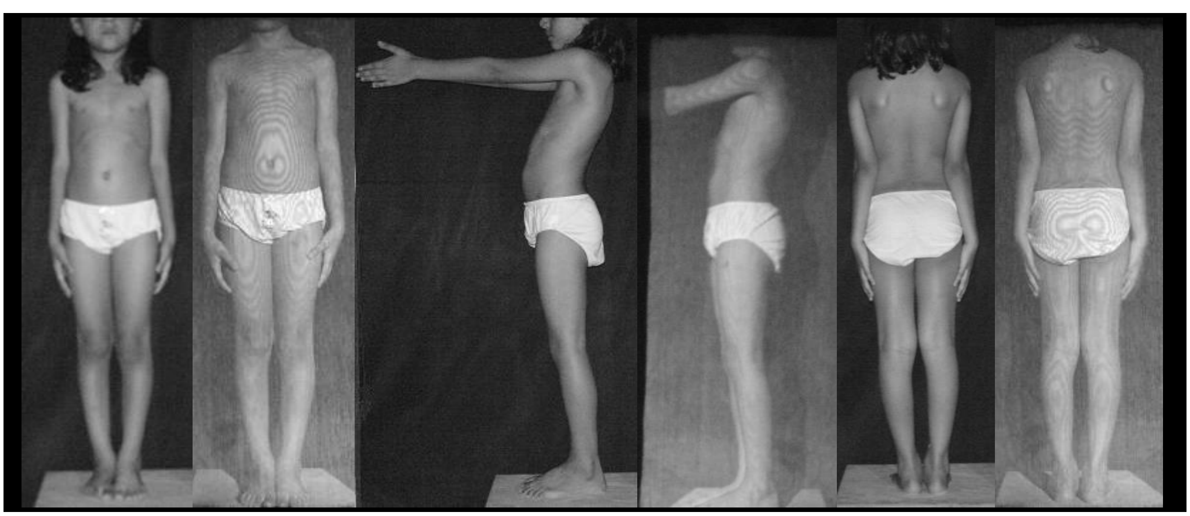


Fig. 2*a-f*. Posture and moiré photographs of Z. H. Z. taken on May 13, 2012.
Drooping left shoulder is visible in posture (*e*) and moiré (*f*) photographs.

Table 3*a*. Adult-mid-parental (Target) and army-cutoff heights for Z. Family

Father's Height**:** ♂ 178.20 *cm* • Mother's Height**:** ♀ 170.78 *cm*

Adult-Mid-Parental (Target) and Army-Cutoff Heights	*Boy* ♂		*Girl* ♀	
	Target	*Army-Cutoff*	*Target*	*Army-Cutoff*
Case Number	**SGPP-KHI-20110412-01**			
Height (*cm*)	180.99	162.56	167.99	157.48
Height (*ft-in*)	5 *ft* 11.26 *in*	5 *ft* 4.00 *in*	5 *ft* 6.14 *in*	5 *ft* 2.00 *in*
Percentile	73.72	2.72	76.12	19.36

Growth-and-Obesity Roadmap shows that Z. H. Z. was wasted during her first 3 checkups, but became obese afterwards. However, she remained stunted (with respect to current-age-mid-parental height) throughout this period — her parents being tall (father 178.20 *cm*; mother 170.78 *cm*), the target (adult-mid-parental) height came out to be 167.99 *cm* (5 *feet* 6.14 *inches*) lying at 76th *percentile* (76.12 to be exact) according to Growth Charts and Tables published by our group (Kamal and Jamil, 2014), which are extensions of CDC (Centers for Disease Control and Prevention) Growth Charts and Tables.

Parents' obesity statuses were, also, determined, which showed that father was obese, whereas mother was wasted. Hence, Z. H. Z.'s marginal obesity trend during the last 2 checkups may have familial basis (Kamal *et al.*, 2011; Ajslev et al., 2014).

Z. H.Z.'s heights and masses (weights) were monitored from the age of 5.88 *years* to 9.44 *years*. Her height climbed from 46th *percentile* (46.42 to be exact) at 1st checkup to 58th *percentile* (58.22 to be exact) at 5th checkup, with an anomaly at 4th checkup (the value of percentile 4.54 may be due to measurement or recording error).

Table 3*a* lists target and army-cutoff heights as well as corresponding percentiles. Table 3*b* gives Obesity Roadmaps of parents. These are different from Obesity Profiles given in (Kamal *et al.*, 2011), as the current computations include recommendations for month-wise mass management.

Since both parents are above the age of 30, their optimal masses were computed by considering 24 kg/m^2 as reference body-mass index (*BMI*). Optimal mass was evaluated by multiplying this value with square of height, expressed in *meters*. In fact, for persons older than 30 years, values of height and mass read from extended-gender-specific tables for the age of 20 *years* (http://www.ngds-ku.org/Papers/J34/Additional_File_3.pdf) may be misleading to compute percentiles. Actually, distribution of weight changes, significantly, as years are added up to an individual's age. Hence, it is not recommended to compute such percentiles, as they are not needed to generate Obesity Roadmaps.

Table 3*b*. Obesity Roadmaps of Parents of Z. Family

Father's Date of Birth (*year-month-date*)**:** ♂ 1977-10-23 • Mother's Date of Birth (*year-month-date*)**:** ♀ 1980-06-10

	Father	*Mother*
Case Number	**SGPP-KHI-20110412-01**	
Date of Checkup (*year-month-date*)	2012-05-13	2012-05-13
Age (*year-month-date*)	34-06-20	31-11-03
Decimal Age (*year*)	34.56	31.92
Dress Code[a]	1.5/2	2/2
Height, *h* (*cm*)	178.20	170.78
Height (*ft-in*)	5 *ft* 10.16 *in*	5 *ft* 7.24 *in*
Gross Mass (*kg*)	92.80	61.63
Clothing Correction (*kg*)	0.30	0.30
Net Mass, μ (*kg*)	92.50	61.33
Net Weight (*lb-oz*)	203 *lb* 15.40 *oz*	135 *lb* 3.72 *oz*
*BMI***:** Body-Mass Index (kg/m^2)	29.13	21.03
Optimal Mass (*kg*)	76.21	70.00
Δ Mass-for-Height	+16.29	–8.67
Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	+32.40%	–12.38%
Qualitative Status (pertaining-to-mass)[b]	**4th-Degree Obese**	**2nd-Degree Wasted**
6-Month-Mass Management (*kg*)	–10.00	+8.67
Month-Wise-Mass Management (*kg/month*)	**–1.67**	**+1.44**
Month-Wise-Mass Management (*lb-oz/month*)	–3 *lb* 10.80 *oz*	+3 *lb* 2.97 *oz*

Table 3*c*. Growth-and-Obesity Roadmap of Z. H. Z. (1st to 3rd checkups)

Gender**:** Female • Date of Birth (*year-month-date*)**:** 2005-06-16 • School**:** Withheld • GR Number**:** Withheld

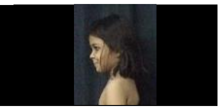
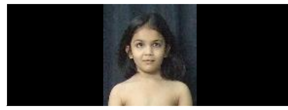
Checkup	*1st*	*2nd*	*3rd*
Case Number	**SGPP-KHI-20110412-01/01**		
Photograph[c]			
Scanned Signatures[c]	*ZHZ*	*ZHZ*	*ZHZ*
Class	KG	I	I
Date of Checkup (*year-month-date*)	2011-05-04	2012-03-20	2012-05-13
Age (*year-month-date*)	05-10-18	06-09-04	06-10-27
Decimal Age (*years*)	5.88	6.76	6.91
Dress Code[a]	0/0.5	0/0.5	0/0.5
Behavior Code[d]	0	0	0
Cumulative-Scoliosis-Risk Weightage[e]	0.50	1.00	6.50
Height, h (*cm*)	113.40	119.42	120.45
Height (*ft-in*)	3 *ft* 8.65 *in*	3 *ft* 11.02 *in*	3 *ft* 11.42 *in*
Percentile-for-Height, $P(h)$	46.42	46.65	47.02
Estimated-Adult Height (*cm*)	162.71	162.75	162.82
Estimated-Adult Height (*ft–in*)	5 *ft* 4.06 *in*	5 *ft* 4.08 *in*	5 *ft* 4.10 *in*
Current-Age-MP Height (*cm*)	117.64	123.90	124.92
Δ Height *w. r. t.* Current-Age-MP (*cm*)	–4.24	–4.48	–4.47
Status (pertaining-to-height), $STATUS_{\pm}(h)$	–3.60%	–3.61%	–3.58%
Qualitative Status (pertaining-to-height)[f]	**1st-Degree Stunted.**	**1st-Degree Stunted.**	**1st-Degree Stunted.**
Current-Age-Army-Cutoff Height (*cm*)	109.45	115.19	116.12
Δ Height *w. r. t.* Army-Cutoff (*cm*)	+3.95	+4.23	+4.33
Reference Height (*cm*)	117.64	123.90	124.92
Percentile-for-Reference-Height	76.12	76.12	76.12
Age of Prediction, *A*+ (*years*)	6.39	7.26	7.41
Reference Height at *A*+ (*cm*)	121.28	127.28	128.24
6-Month-Height Management (*cm*)	+7.88	+7.86	+7.79
Month-Wise-Height Management (*cm/month*)	**+1.31**	**+1.31**	**+1.30**
Month-Wise-Height Management (*in/month*)	+0.52	+0.52	+0.51
Gross Mass (*kg*)	18.30	20.14	20.74
Clothing Correction (*kg*)	0	0	0
Net Mass, μ (*kg*)	18.30	20.14	20.74
Net Weight (*lb-oz*)	40 *lb* 5.62 *oz*	44 *lb* 6.54 *oz*	45 *lb* 11.71 *oz*
Percentile-for-Net-Mass $P(\mu)$	26.81	26.07	29.25
Estimated-Adult Mass (*kg*)	52.89	52.73	53.45
Estimated-Adult Weight (*lb–oz*)	116 *lb* 10.08 *oz*	116 *lb* 4.26 *oz*	117 *lb* 13.89 *oz*
*BMI***:** Body-Mass Index (kg/m^2)	14.23	14.12	14.30
Estimated-Adult BMI (kg/m^2)	19.98	19.91	20.16
Optimal Mass (*kg*)	19.70	21.86	22.26
Δ Mass-for-Height (*kg*)	–1.40	–1.72	–1.52
Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	–7.12%	–7.86%	–6.85%
Qualitative Status (pertaining-to-mass)[b]	**1st-Degree Wasted**	**1st-Degree Wasted**	**1st-Degree Wasted**
Optimal Mass for Reference Height at *A*+ (*kg*)	23.88	26.68	27.18
6-Month-Mass Management (*kg*)	+5.58	+6.54	+6.44
Month-Wise-Mass Management (*kg/month*)	**+0.93**	**+1.09**	**+1.07**
Month-Wise-Mass Management (*lb-oz/month*)	+2 *lb* 0.81 *oz*	+2 *lb* 6.46 *oz*	+2 *lb* 5.87 *oz*
Nutritional Status	Under-Nutrition	Under-Nutrition	Under-Nutrition
Built	Medium	Medium	Medium

Table 3*c* lists Growth-and-Obesity Roadmap of Z. H. Z. for the first 3 checkups, a child of medium built, who showed signs of under-nutrition (coexistence of stunting and wasting). Mass percentile dropped from 1st to 2nd check-

Table 3*d*. Growth-and-Obesity Roadmap of Z. H. Z. (4th and 5rh checkups)

Gender**:** Female ♀ • Date of Birth (*year-month-date*)**:** 2005-06-16 • School**:** Withheld • GR Number**:** Withheld

Checkup	*4th*	*5th*
Case Number	**SGPP-KHI-20110412-01/01**	
Photograph[c]		
Scanned Signatures[c]	ZHZ	ZHZ
Class	II	IV
Date of Checkup (*year-month-date*)	2013-06-02	2014-11-21
Age (*year-month-day*)	07-11-16	09-05-07
Decimal Age (*years*)	7.96	9.44
Dress Code[a]	0/0.5	0/0.5
Behavior Code[d]	0	0
Cumulative-Scoliosis-Risk Weightage[e]	5.75	11.50
Height, *h* (*cm*)	117.84	136.56
Height (*ft-in*)	3 *ft* 10.39 *in*	4 *ft* 5.76 *in*
Percentile-for-Height, *P*(*h*)	4.54	58.22
Estimated-Adult Height (*cm*)	152.30	164.77
Estimated-Adult Height (*ft–in*)	4 *ft* 11.96 *in*	5 *ft* 4.87 *in*
Current-Age-MP Height (*cm*)	131.65	139.81
Δ Height *w. r. t.* Current-Age-MP (*cm*)	–13.81	–3.25
Status (pertaining-to-height), $STATUS_{\pm}(h)$	–10.49%	–2.32%
Qualitative Status (pertaining-to-height) [f]	**2nd-Degree Stunted.**	**1st-Degree Stunted.**
Current-Age-Army-Cutoff Height (*cm*)	122.27	129.51
Δ Height *w. r. t.* Army-Cutoff (*cm*)	–4.43	+7.05
Reference Height (*cm*)	131.65	139.81
Percentile-for-Reference-Height	76.12	76.12
Age of Prediction, *A*+ (*years*)	8.46	9.93
Reference Height at *A*+ (*cm*)	134.54	142.52
6-Month-Height Management (*cm*)	+16.70	+5.96
Month-Wise-Height Management (*cm/month*)	**+2.78**	**+0.99**
Month-Wise-Height Management (*in/month*)	+1.10	+0.39
Gross Mass (*kg*)	25.12	33.06
Clothing Correction (*kg*)	0	0
Net Mass, μ (*kg*)	25.12	33.06
Net Weight (*lb-oz*)	55 *lb* 6.23 *oz*	72 *lb* 14.36 *oz*
Percentile-for-Net-Mass $P(\mu)$	46.25	63.50
Estimated-Adult Mass (*kg*)	57.36	62.34
Estimated-Adult Weight (*lb–oz*)	126 *lb* 7.56 *oz*	137 *lb* 7.37 *oz*
BMI: Body-Mass Index (kg/m^2)	18.09	17.73
Estimated-Adult BMI (kg/m^2)	24.73	22.96
Optimal Mass (*kg*)	19.85	32.12
Δ Mass-for-Height (*kg*)	+5.27	+0.94
Status (pertaining-to-mass), $STATUS_{\pm}(\mu)$	+26.54%	+2.94%
Qualitative Status (pertaining-to-mass)[b]	**3rd-Degree Obese**	**1st-Degree Obese**
Optimal Mass for Reference Height at *A*+ (*kg*)	31.16	37.94
6-Month-Mass Management (*kg*)	+6.04	+4.88
Month-Wise-Mass Management (*kg/month*)	**+1.01**	**+0.81**
Month-Wise-Mass Management (*lb-oz/month*)	+2 *lb* 3.52 *oz*	+1 *lb* 12.69 *oz*
Nutritional Status	Energy-Channelization II	Energy-Channelization II
Built	Medium	Medium

up, indicating pseudo gain (Kamal *et al.*, 2014*b*). Table 3*d* gives Growth-and-Obesity Roadmap of Z. H. Z. for the last 2 checkups, her built remained medium, but nutritional status shifted to energy-channelization II (coexistence of

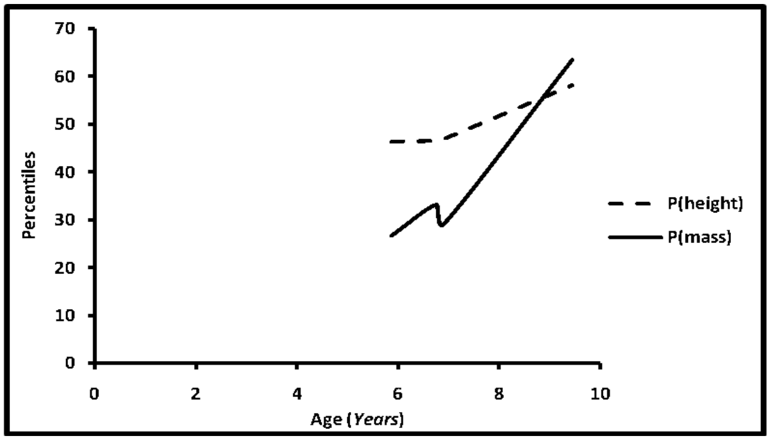


Fig. 3. Height and mass percentiles of Z. H. Z. in the age range 5.88-9.44 years. Height percentile 4.54 (4^{th} checkup) is considered as outlier and not included in drawing graph.

stunting and obesity). Figure 3, graphically, depicts percentile trajectories of height and mass for her 5 checkups. It could be noted that mass-percentile trajectory crossed height-percentile trajectory when Z. H. Z.'s age was 8.91 *years*. Hence, she momentarily achieved optimal mass, but did not maintain the same.

Table 4. Month-wise-height and -mass management for Z. H. Z. based on her most-recent checkup

Targets	**Height Management**		**Mass Management**	
(on specific dates of each month)	*cm*	*ft-in*	*kg*	*lb-oz*
December 23, 2014	137.55	4 *ft* 6.15 *in*	33.87	74 *lb* 11.05 *oz*
January 23, 2015	138.55	4 *ft* 6.55 *in*	34.69	76 *lb* 7.75 *oz*
February 23, 2015	139.54	4 *ft* 6.94 *in*	35.50	78 *lb* 4.44 *oz*
March 23, 2015	140.53	4 *ft* 7.33 *in*	36.31	80 *lb* 1.13 *oz*
April 23, 2015	141.53	4 *ft* 7.72 *in*	37.13	81 *lb* 13.82 *oz*
May 23, 2015	142.52	4 *ft* 8.11 *in*	37.94	83 *lb* 10.52 *oz*

Although, Z. H. Z. was tall by community standards, she was advised to gain height as well as mass based on percentile of mid-parental height. Her mass climbed from 27^{th} *percentile* (26.81 to be exact) at 1^{st} checkup to 64^{th} *percentile* (63.50 to be exact) at 5^{th} checkup. She was 7.12% (1^{st}-degree) wasted and 3.60% (1^{st}-degree) stunted at her first checkup. However, at her most-recent (5^{th}) checkup, she was 2.94% (1^{st}-degree) obese as well as 2.32% (1^{st}-degree) stunted. Mother seemed to be concerned about her obesity. She was given specific targets to achieve particular values of height and mass on given dates, so that she attains and maintain optimal mass-for-recommended height (6 *month* down the road), which in her case is the height corresponding to mid-parental height on May 23, 2015 (Table 4). In order to achieve these targets, she was provided guidelines, which included changes in lifestyle as well as appropriate diet and exercise plans (Table 5).

Table 5. Lifestyle adjustment, diet and exercise plans for Z. H. Z. 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; 8-hour night-time sound sleep	
Diet plans	3 relaxed and balanced meals; 10-12 glasses of water daily	
	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 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

DISCUSSION AND CONCLUSION

This paper highlighted the issue of obesity among children. Discretion is advised, when suggesting children to reduce mass (weight), as an overemphasis on body image may bring about tendencies of anorexia nervosa or, worse still, bulimia nervosa. Certainly, cases exist, in which an excessively obese child is advised to shed off mass (Kamal *et al.*, 2015*c*). However, in most of the other cases, a better strategy is to manage height according to mass, so that the child, not only, possesses optimal mass for a short span of time, but also, maintains the same throughout life. Actually, maintenance of optimal mass is possible when values as well as slopes match for percentile curves of height and mass (dynamical-system approach). Such a concept has, already, been applied by the author in the context of a control law for satellite-launch vehicles — matching of positions and velocities (Kamal and Mirza, 2006). In fact, optimal-mass management is an optimal solution (Kamal *et al.*, 2013; 2014*b*) of diet, exercise and lifestyle adjustment (optimization approach).

The obesity epidemic progressed at a rapid pace not only in the Western world but also as a pandemic in other parts of the globe with the exception of those areas, which have food shortages as well as famines (Sørensen, 2009). Han *et al*. (2010) are of the opinion that there is a need of reassessment of intake of calories and recommendation of physical activities so that there is an improved quantification at a population level because of sedentary lifestyles of youngsters these days. Sørensen (2014) mentions that the biggest challenge in learning about obesity development is uniting the evidence about the apparent multitude of determinants.

A humble attempt has been made by our group to generate month-wise recommendations to gain height and pick up or shed off mass (weight) through Growth-and-Obesity Roadmaps (Kamal *et al.*, 2015*c*) as well as suggest diet and exercise plans to achieve these objectives (Kamal and Khan, 2014). Our group recommended national-level programs for height and mass monitoring of 3- to 10-year-old boys and girls (Kamal *et al.*, 2004), which could be linked to each other through telemedicine technologies (Kamal *et al.*, 2002), combined with a comprehensive approach to manage pediatric obesity (Miller and Silverstein, 2007).

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ENDNOTES

[a]Dress Code is explained in (Kamal, 2006; Kamal *et al.*, 2002). Father's dress code 1.5/2 means barefoot, T-shirt and trousers, mother's dress code 2/2 means barefoot, 'shalwar' (trousers) and 'kameez' (shirt) without scarf. Z. H. Z.'s dress code 0/0.5 means barefoot, panties only, stripped-to-waist

[b]Qualitative status (pertaining-to-mass) is assigned from sign and value of algebraic status (pertaining-to-mass), $STATUS_{\pm}(\mu)$, negative sign means wasting and positive sign obesity, 1% deviation (on either side) is considered normal, (1-10)% is considered first degree, (10-20)% second degree, (20-30)% third degree and more than 30% fourth degree (Kamal *et al.*, 2015*c*).

[c]Photographs and scanned signatures on the day, check up was conducted. In order to protect the privacy of Z. Family, the photographs, inserted in Z. H. Z.'s Growth-and-Obesity Roadmap, do not show the actual child, although they are from the set of patients, who reported to SF-Growth-and-Imaging Laboratory for checkups. Further, family label and child's initials (Z. H. Z.) do not correspond to first letters in actual names (as per confidentiality standards established by our group). Same is true about the case number appearing in this document. Instead of scanned signatures, initials are printed, again, to safeguard privacy. Photographs of children shown for 1st and 5th checkups first appeared in (Kamal *et al.*, 2011) and those for 2nd to 4th checkups in (Kamal *et al.*, 2015*c*), both papers published in this journal.

[d]Behavior code is explained in (Kamal, 2006; Kamal *et al.*, 2002). A behavior code 0 means child was relaxed and coöperative.

[e]Cumulative-Scoliosis-Risk Weightage (CSRW) is described in (Kamal *et al.*, 2015*a*).

[f]Qualitative status (pertaining-to-height) is assigned from sign and value of algebraic status (pertaining-to-height), $STATUS_{\pm}(h)$, negative sign means stunting and positive sign tallness, 1% deviation (on either side) is considered normal, (1-10)% is considered first degree, (10-20)% second degree, (20-30)% third degree and more than 30% fourth degree (Kamal *et al.*, 2015*c*).

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