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Growth-and-Obesity Vector-Roadmaps Generated using Enhanced Anthropometric Instruments: The Fourth-Generation Solution of Childhood Obesity[§]

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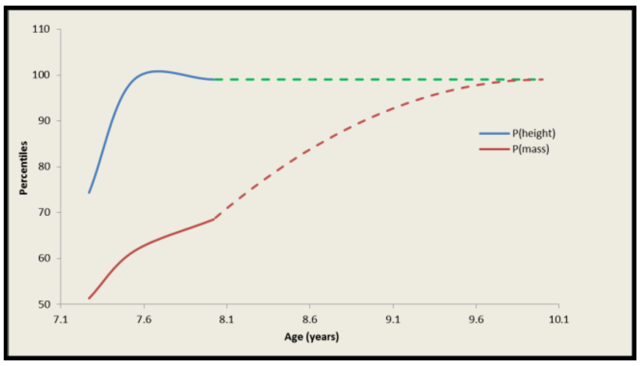

Time evolution of L. G.'s height and mass percentiles for her three checkups in the age range 7.27-8.02 *years* (navigational trajectory: solid curve), including the desired course-of-action (guidance trajectory: green-dashed line) and recommended intervention (control action: maroon-dashed for mass)

The American Medical Association declared obesity as a disease in 2013. The pandemic development of this disease in children with associated consequences in psychological, physical and social domain in a cause of concern for all. The first lady of United States, **Her Excellency, Michelle Obama** declared childhood obesity an epidemic for her country. There is a need for a sophisticated mathematical modeling to take up this issue. During 2013-2015 our group proposed 1st- to 3rd-Generation Solutions of Childhood Obesity (http://www.ngds-ku.org/Presentations/Childhood-Obesity.pdf). In this work we are putting forward 4th-Generation Solution of Childhood Obesity in the form of Growth-and-Obesity Vector-Roadmaps generated using enhanced anthropometric instruments. These maps are generated from a series of height and mass measurements obtained by reproducible anthropometrists (child barefoot, stripped to short underpants, elbows and knees not flexed, instructed to inhale completely) using 'Extended CDC Growth Charts and Tables', which have heights and masses listed for extreme percentiles — 0.01th, 0.1th and 1st as well as 99th, 99.9th and 99.99th, in addition to entries between 3rd and 97th percentiles (http://www.ngds-ku.org/Papers/J34/Additional_File_3.pdf). Our group has been recording heights and masses to least counts of 0.01 *cm* and 0.01 *kg*, respectively, since 2011 using standard protocols (http://www.ngds-ku.org/ngds_folder/M02.pdf). This year these least counts have been reduced to 0.005 *cm* and 0.005 *kg* by constructing new Vernier scales in which 19 divisions on main scale (engineering tape for height measurement; upper scale, range 20 *kg*, of the beam scale for mass measurement) are matched with 20 divisions on Vernier scale constructed by mounting a triangular paper strip on the edge of a setsquare and drawing 20 parallel lines. The Vector-Roadmap is different from the Scalar-Roadmap (http://www.ngds-ku.org/Papers/J35.pdf) in the sense that child is required to pick up height or gain/lose mass gradually (not abruptly within the next 6 *months*) till the child enters peripubertal phase (taken as age 10 *years* for the purpose of calculations in this model), to avoid unnecessary stress on a child's skeleton realizing that a quasi-static process, tissue synthesis, represents height gain. On the date of most-recent checkup, a control action is applied so that both height and mass percentiles are directed to approach reference percentile (maximum of percentiles of measured height, target height and army-cutoff height) at the age of 10 *years* by fitting a parabolic curve. Role of source function in radiative-transfer equation best describes function of reference-percentile line. The softer targets (as compared to the scalar model, see table below) would, hopefully, be easier to attain within the next half-year. The model is illustrated through a sample case of L. G., a girl participating in gymnastics. No manipulation was needed for the height-percentile curve, as her measured height was the reference height, whereas a parabolic curve is fitted for the mass-percentile curve. Height, h, and mass, μ, percentiles, as functions of age, A, during the intervention period (see figure above), may be expressed as $P(h, A) = 99.058$ and $P(\mu, A) = 99.058 - 7.779(A - 10)^2$. Month-wise recommendations (height and mass management), based on the vector model and the scalar model, are compared. L. G.'s Growth-and-Obesity Scalar- and Vector-Roadmaps are given in **Additional File 1** (http://www.ngds-ku.org/Presentations/Vector/Additional_File_1.pdf) and **Additional File 2** (http://www.ngds-ku.org/Presentations/Vector/Additional_File_2.pdf), respectively.

Comparison of month-wise-height and -mass (-weight) management for L. G. (SGPP-KHI-20131021-02/01) generated from the vector model and the scalar model (http://www.ngds-ku.org/paper/J35.pdf)

Gender: Female • *Date of Birth* (*year-month-day*): 2007-08-15 • *Army-Cutoff Height*: 157.48 *cm* (19.36^{P})
Date of Last (*Fourth*) *Checkup* (*year-month-day*): 2015-08-22 • *Decimal Age*, A_0 = 8. 019178082 *years*
Father's Height: 167.16 *cm* • *Mother's Height*: 160.16 *cm* • *Target Height*: 157.16 *cm* (18.14^{P})
$P_{\mathrm{ref}} = 99.05807563$ • $P(h, A_0) = 99.05807563$ • $P(\mu, A_0) = 68.53601694$

Target Date	*Height* (h) *Target* (*cm*)			*Mass* (μ) *Target* (*kg*)		
	VECTOR MODEL	SCALAR MODEL	Δh	VECTOR MODEL	SCALAR MODEL	$\Delta\mu$
September 22, 2015	144.05	144.04	+0.01	28.88	31.33	–2.45
October 22, 2015	144.58	144.58	0	29.31	34.45	–5.41
November 22, 2015	145.12	145.11	+0.01	30.31	37.56	–7.25
December 22, 2015	145.66	145.65	+0.01	31.28	40.68	–9.40
January 22, 2016	146.18	146.18	0	32.21	43.80	–11.59
February 22, 2016	146.72	146.72	0	33.05	46.92	–13.87

Keywords: Month-wise recommendations of height/mass, lifestyle adjustment, diet and exercise plans

Web address of this document: http://www.ngds-ku.org/Presentations/Vector.pdf
HTML version: http://www.ngds-ku.org/pub/confabstB.htm#C133:

[§]SAK was responsible for conceptualization and overall management of the project, AAN developed the model, SM fabricated instruments used for enhanced anthropometric measurements and SAA wrote computer programs.

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