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Research article

Cut-off heights for induction into the Armed Forces of Pakistan: Adequacy of criteria for still-growing youth

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Abstract

This paper analyses induction criteria of still growing youth (under-19 females; under-21 males) in the Armed Forces of Pakistan to determine whether the different sexes have the same chances of being selected. Standing heights of 1,666 students (1,163 females; 503 males) were measured, enrolled in the Pakistani schools (Armed Forces and civilian). Convenience sampling was employed to collect data. The percentage of females and males qualifying for the military service was determined by computing their estimated adult heights. Cut-off heights for induction in the Pakistani Armed Forces are 157.48 cm for females and 162.56 cm for males, corresponding to CDC (scaled) percentiles of height 19.36 (25.86) for females and 2.72 (3.82) for males. The analysis showed that 68.44% of the females fulfilled the induction criteria, whereas 94.43% of the males qualified for service in the forces. CDC cut-off (scaled) percentile for induction of females is set higher than the corresponding percentile for males. Based on the cut off-height criterion, the percentage of females eligible for selection in the Armed Forces of Pakistan is significantly lower than the corresponding percentage for males. Therefore, there is a need to establish adequate criteria, which should qualify equal percentages of females and males for such careers.

KEYWORDS: estimated adult height, height and mass management, optimal mass, percentile

Introduction

Height is a direct and easily available measure of long-term and life-course health (Bozooli et al., 2009). Growing tall is not enough: there should be proportionate growth for a well-developed personality. Baten and Blum (2012) presented findings and background evidence on anthropometric welfare in 156 countries from 1810 to 1989. In a more recent study, the height and weight trends for the population of the island of Crete before and after its annexation by Greece were studied (Capocasa et al., 2019). Some recent studies on children's heights in Pakistan included the relationship of socio-demographic factors with malnutrition in preschool children (Shafqat et al., 2013) and anthropometric characteristics and physical fitness of 8-10-year-old females (Haq et al., 2019). Of prime importance is the measurement of a student's height, which should be able to predict, based on mathematical-statistical techniques, the trajectory on which that particular student is at the time of check-up, so that estimated adult height may be computed. In this way, parents can know whether their child would qualify for induction in the Armed Forces of Pakistan based on the required height. Checkups performed in different countries provide an approximate estimated adult height from growth chart plots. However, we provide a method to determine this height to 2 decimal places (in centimetres).

There are not many studies of heights and weights of the youth of military age. Karpinos published findings on height-weight data derived from reports of medical examinations of youths of the United States, checked for military service during January 1943 to January 1944 (Karpinos, 1958) and January 1957 to September 1958 (Karpinos, 1961). Of all the youths reporting for induction, those selected proved to be taller and heavier. Papadimitriou et al. (2008) measured the heights and weights of 3,982 conscripts aged 18–26 years during 2006/07 from pre-selected army camps all over Greece. The data were compared with a similar study conducted in 1990 (Georgiadis et al., 1993). Their data showed an increase in the stature of young Greek men over the previous 16 years. Bailey et al. (2016) examined the health and height of men from England and Wales born in the 1890s who enlisted in the army during World War I. Dāboliņa et al. (2017) obtained anthropometric data of 150 male soldiers of the Latvian army using non-contact anthropometric methods (3D anthropometric scanner), which consisted of three heights (standing, waist, and crotch) and the circumferences (bust, waist and hip) for the planned design of uniforms. Banjevic (2020) investigated the morphological and functional characteristics of army recruits and professional soldiers of the Montenegro Armed Forces. Anthropometric measurements, which included standing heights, of 25 recruits from the Training Centre in Danilovgrad and 25 professional soldiers of the Navy and the Infantry Battalion of Montenegro Armed Forces were obtained and an-

alysed. They concluded that there is a high coincidence with the majority of morphological and functional parameters.

In the present paper, we investigate the rationale of measuring the height of young people in early childhood, later childhood, early adolescence and later adolescence and use mathematical techniques to compute/estimate adult height (a theoretical estimate) at around age 20. This estimated adult height is obtained from the percentile of height, generated using CDC Growth Charts and Tables, which indicates the final height to be attained by a young person, provided the incumbent stays on the same percentile. Some children will grow to be taller, either because of natural causes or interventions (increasing sleep hours, engaging in exercises for height development, consuming of nutritious diet that contributes to height gain, emotional stability, etc.), whereas others would fail to achieve their full growth potential because of various factors (neglect, abuse, lack of sleep, exercise or non-availability of balanced diet). Failure to gain height is considered one of the earliest warning signs that require a complete physical and psychological examination to uncover the underlying causes. However, measurement of height at an early age and computing the difference from current-age army-cut-off height (height extrapolated to the current age from the adult-army-cut off height) would provide sufficient opportunities for parents, dieticians, physical education teachers and sport coaches to devise and implement lifestyle adjustment and diet-and-exercise plans, in order to achieve the optimal height required for induction into the Armed Forces of Pakistan. The intent of young people as well as their parents (in particular, those already in uniform) to serve in the army would not be shattered to discover, at the age of say 18 or 19 years, that their heights are not up to the requirements set for induction into the military or paramilitary occupations. At that stage, not much could be done as it is generally understood that females stop gaining hight by the age of 19 and males by the age of 21.

Research problem

Kamal, Ansari, Sarwar & Naz (2017) computed CDC percentiles (percentiles computed on the basis of CDC Growth Charts and Tables) of cut-off (standing) heights of males and females for induction into the Armed Forces of Pakistan. It was suggested that for the purpose of induction of still-growing males and females, their measured standing heights should not be considered, but the corresponding CDC percentiles should be considered. cut-off heights for military and paramilitary occupations in Pakistan are set at 5 ft 2 in (157.48 cm) for females (CDC percentile 19.36; scaled percentile 25.86) and 5 ft 4 in (162.56 cm) for males (CDC percentile 2.72; scaled percentile 3.82). The methods to

compute percentiles of height (both CDC and scaled) for still-growing youth are briefly described in the methods and procedures section.

One notes that the cut off CDC (scaled) height percentile for females is seven times higher than the corresponding percentile for males (Kamal, Ansari, Sarwar & Naz, 2017). This paper aims to investigate the percentage of females qualifying for service compared to the corresponding percentage for males to determine the adequacy of induction criteria.

About the NGDS Pilot Project study

Subjects

A total of 1,666 students from four schools participated in the study; three of the schools were run by the Armed Forces of Pakistan (one each belonging to the Pakistan Army, Navy and Air Force) and the fourth one a civilian school in a middle-class locality. Schools run by the Armed Forces admitted children of the military personnel; children of some civilian personnel are also granted admission. No special admission criteria are in place. The curricula in these schools are designed so that the depth, breadth, and scheduling of topics are the same throughout Pakistan. In this way, the students have no problem continuing their education in a school in another province if their fathers are posted elsewhere.

After approximately ten years of study, students (around 15–16 years old) may apply for induction in the Armed Forces of Pakistan. They are subjected to rigorous physical and psychological examinations as well as fitness testing. To be medically fit, the candidates must have a certain minimum height (allowance is given to still-growing youth if they do not have the prescribed height at the age of 20 years. In addition, their knees should not touch during posture examination and should not knock during running. Males must have a difference of at least 2 cm between expanded and unexpanded chest circumferences.

The sample included females and males from all over Pakistan; their age range included early childhood (from 3.2 years to 9.5 years), later childhood (from 9.5 years to 12.0 years), early adolescence (from 12.0 years to 13.5 years) and later adolescence (from 13.5 years to 14.63 years).

Informed consent was obtained from the parent(s) of each participating student for the school-based study (the NGDS Pilot Project), opt-in policy, as well as parents for the family-centred study (SGPP).

Table 1 shows descriptive statistics (qualitative and quantitative) of the 1,666 students included in the study.

Table 1: Descriptive statistics

Data collected during 1998-2016	Females	Males	Combined
Number of subjects	1,163 (69.81%)	503 (30.19%)	1,666 (100%)
Mean age in years (SD)	8.51 (1.85)	6.21 (1.70)	7.81 (2.09)
Median (years)	8.64	6.27	7.93
Mode (years)	8.27	6.68	6.68
Range (years)	5.01-14.63	3.20-12.07	3.20-14.63

Study design

Initiated 22 years ago, the NGDS Pilot Project[1] is a longitudinal observational study, designed after consulting with the leading Pakistani and Swedish paediatricians incorporating the applicable ethical protocols (Kamal, Ansari, Sarwar & Naz, 2017, Additional File 1). Checkups were performed, giving due concern for the comfort, confidentiality, dignity, privacy and safety of the examinees (Kamal, Ansari, Sarwar & Naz, 2017). The students were selected based on convenience sampling. A family-centred subproject of the NGDS Pilot Project, the Sibling Growth Pilot Project (SGPP)[2] studied families of selected students whose parents visited Growth-and-Imaging Laboratory for detailed checkups along with their 5- to 10-year-old children.

Methods and procedures

Heights and masses (weights) were measured as per international standards (Kamal, 2016). For height (stature) measurement, floor level was checked using a spirit level, and the undressed student was required to stand next to the mounted engineering tape (plumb line used to ascertain vertical alignment) and instructed to place palms on thighs and hold heels together in attention position; the student was asked to inhale fully to achieve maximum chest expansion and minimum waist. A pencil was held at eye level to ensure that the student's chin was parallel to the floor. Figure 1 illustrates the height-measurement procedure (Kamal et al., 2020a, Additional File 1).

[1] For more information see https://ngds-ku.org

[2] For more information see https://www.ngds-ku.org/ngds_URL/subprojects.htm#SGPP

From the values of heights and masses, Growth-and-Obesity Vector-Roadmaps 2.5[3] of selected students were generated. The profile portion was divided into five parts: header, vital statistics, height data, mass (weight) data and combined data (height and mass).

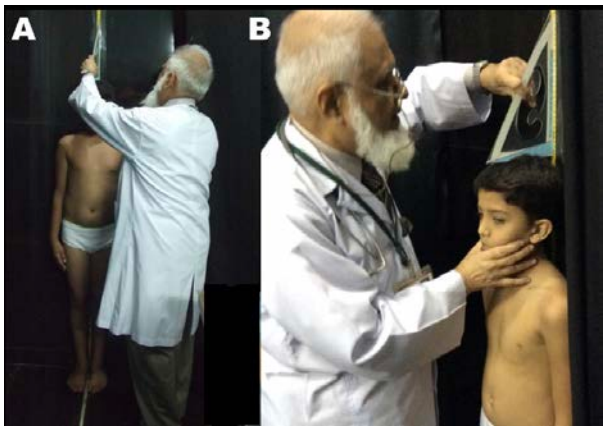


Figure 1: *Measurement of height of a boy; A illustrates posture during the process* and *B shows the alignment of the set square on the head of a boy*

Height data included measured height (both in cm and ft-in), estimated adult height (both in cm and ft-in), current-age-army-cut-off height (in cm), as well as the difference of measured height and current-age-army-cut off height (in cm). The recommendation portion gave six-month-wise targets of height and mass (weight) range.

Height targets were generated on the basis of reference percentile, which was taken as maximum of percentile-of-height, percentile-of-army-cut-off height and percentile-of-mid-parental height. The compliance portion computed the height-gain-target-achievement index and mass-management-target-achievement index based on the recommended values generated from the previous check-up and measured values of height and mass. The detailed method of construction of Roadmap 2.5 is explained elsewhere (Kamal et al. 2020, Additional File 4).

In the earlier study dealing with cut-off heights, Growth-and-Obesity Vector-Roadmap 1.1 of HrS (initials not corresponding to the first alphabets of child's name to protect privacy) was given (Kamal, Ansari, Sarwar & Naz, 2017). The data of the same child are processed employing the most-recent model, Growth-and-Obesity Vector-Roadmap 2.5 (Kamal et al., 2020), for comparison purposes. Figure 2 shows the evolution of height and mass CDC percentiles of HrS for her three checkups in the age range of 7.26-8.62

[3] Growth-and-obesity Vector-Roadmaps are mathematical-statistical techniques, developed by the "National Growth and Developmental Standards for the Pakistani Children" team. The Roadmaps are used to determine growth and obesity statuses of children as well as propose solutions for weight management.

years. It would be interesting to compare this figure with Figure 2, appearing in Kamal, Ansari, Sarwar & Naz (2017).

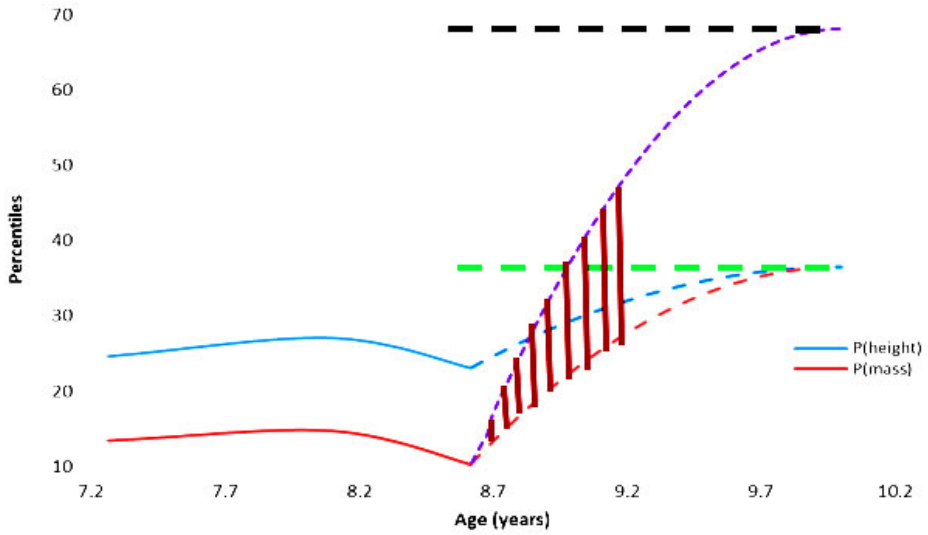


Figure 2: *Time evolution of height and mass CDC percentiles of HrS for her three checkups*

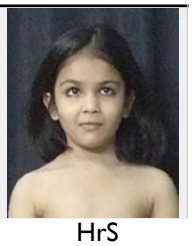
The age range was 7.26–8.62 years (navigational trajectories: solid curves), including the desired course of action (guidance trajectories: green-dashed line for reference percentile, black-dashed line for reference BMI-based optimal mass percentile) and recommended intervention (control-action trajectories: blue-dashed for height-percentile curve and maroon-shaded for mass-percentile curve) based on Growth-and-Obesity Vector-Roadmap 2.5

Tables 2 to 5 give a sample roadmap of HrS. One may compare the Growth-and-Obesity Profile (Table 2) with Table 2a included in Kamal, Ansari, Sarwar & Naz (2017). Similarly, six-monthly recommendations of height and mass (Table 3) may be compared with similar recommendations (Table 2b) given in Kamal, Ansari, Sarwar & Naz (2017); the 2017 recommendations give a single value of the mass target, whereas the current recommendations provide a range.

In Table 2, a pseudo-gain of height is exhibited between the 2nd and 3rd checkups: height increased from 124.53 cm to 126.45 cm, CDC height percentile dropped from 27.08 to 23.09; a pseudo-gain of mass is exhibited between the 2nd and 3rd checkups: mass increased from 21.90 kg to 22.53 kg, CDC mass percentile dropped from 14.74 to 10.30. The phenomenon of pseudo-gain of height (mass) was introduced in Kamal et al. (2014). Pseudo-gain of height exists when a height gain is accompanied by a drop in CDC percentile-of-height for two consecutive checkups, with a similar definition for pseudo-gain of mass.

Table 2: *Growth-and-obesity Vector-Roadmap 2.5 of HrS* (*SGPP-KHI-20110614-01/01*)

Gender: female • Date of birth (y-m-d): 2005-04-10 • Adult army cutoff height: 157.48 cm (19.36 percentile)*
Father's height:172.01 cm • Mother's height:162.94 cm • Target height: 160.975 cm (36.49 percentile)

Checkup	**1st**	**2nd**	**3rd**
Photograph**			
Scanned signatures**	HrS	HrS	HrS
Class	I	II	III
Date of Checkup (year-month-day)	15/07/2012	15/05/2013	21/11/2013
Age (year-month-day)	07/03/2005	08/01/2005	08/07/2011
Age (decimal years)	7.26	8.10	8.62
Dress code***	0/0.5	0/0.5	0/0.5
Behaviour code***	0	0	0
Puberty rating	Tanner I	Tanner I	Tanner I
Height (cm)	119.36	124.53	126.45
Height (ft-in) ⇐	3 ft 10.99 in	4 ft 1.03 in	4 ft 1.78 in
CDC percentile of height ⇔	24.63	27.08	23.09
Scaled percentile of height	32.37	35.30	30.49
Current age army cutoff height (cm) ⇐	118.25	122.99	125.64
Δ Height w. r. t.**** current age army cutoff height (cm)	1.08	1.54	0.81
Current age mid-parental height (cm) ⇐	121.15	126.00	128.76
Δ Height w. r. t. current age mid-parental height (cm)	–1.79	–1.47	–2.29
Estimated adult height (cm)	158.87	159.33	158.46
Estimated adult height (ft–in)	5 ft 2.55 in	5 ft 2.23 in	5 ft 2.39 in
Modified status (pertaining to height)	0	0	0
Descriptive status (pertaining to height)	Normal	Normal	Normal
Net mass (kg) ⇒	19.19	21.90	22.53
Net weight (lb-oz)	42 lb 5.02 oz	48 lb 4.63 oz	49 lb 10.86 oz
CDC percentile of net mass ⇔ P	8.13	14.74	10.30
Scaled percentile of net mass	11.49	19.98	14.14
Percentile of BMI-based optimal mass ⇔	57.71	58.86	56.70
BMI-based optimal mass (kg) ⇒	24.39	27.16	28.67
Δ Mass w. r. t. BMI based optimal mass (cm)	–5.20	–5.26	–6.14
Height percentile-based optimal mass (kg) ⇒	21.15	23.47	24.39
Δ Mass w. r. t. height percentile-based optimal mass (cm)	–1.96	–1.57	–1.86
Estimated adult mass (kg)	47.6	49.68	48.46
Estimated adult weight (lb–oz)	104 lb 15.37 oz	109 lb 8.67 oz	106 lb 13.82 oz
Modified status (pertaining to mass)	–9.28%	–6.68%	–7.61%
Descriptive status (pertaining to mass)	1st-deg wasted	1st-deg wasted	1st-deg wasted
Away from normality index	0.0928	0.0668	0.0761
Polar angle	180.00°	180.00°	180.00°
Extended nutritional status	Wasted	Wasted	Wasted
Estimated adult BMI (kg/m2)	18.86	19.57	19.3
Estimated adult-specific BMI	0.786	0.815	0.804
Build	Small	Medium	Small

*Case number shown here not the one appearing in report given to child's parents

**Photographs not showing the patient; initials shown in Roadmap 2.5 not corresponding to first letters in the child's name

*** Dress code 0/0.5 implies that HrS was measured wearing underpants only, barefoot, all clothing above the waist removed; Behaviour code 0 means that HrS was relaxed and cooperative (Kamal, 2016)

**** *w. r. t.* means 'with respect to'

Table 3: *Height-gain target achievement index, and mass-management target achievement index of HrS at her third checkup*

	Measured height		Measured mass (weight)	
	cm	**ft-in**	**kg**	**lb-oz**
November 21, 2013	126.45	4 ft 1.78 in	22.53	49 lb 10.86 oz
	127.92	4 ft 3.17 in	24.65-26.07	54 lb 5.54 oz - 57 lb 7.91 oz
Target-achievement index*	98.85%		91.41% ↓	
Qualitative	under-achieved		under-achieved (outside the normal range)	

*Targets, computed by Growth-and-Obesity Vector-Roadmap 2.5 model.

Table 4: *Month-wise height targets and mass (weight) target ranges for HrS*

Reference Height* = 128.76 *cm* • Percentile of reference height = 36.49 percentile
Estimated adult-reference *BMI* based optimal mass = 62.19 *kg*
Percentile of reference *BMI*-based optimal mass = 63.01percentile

	Height Target		Mass (weight) target Range	
Target date	**cm**	**ft-in**	**kg**	**lb-oz**
November 21, 2013**	126.45	4 ft 1.78 in	22.53	49 lb 10.86 oz
December 21, 2013	127.22	4 ft 2.09 in	23.18–23.63	51 lb 1.74 oz - 52 lb 1.65 oz
January 21, 2014	127.9	4 ft 2.36 in	23.83–24.74	52 lb 8.89 oz - 54 lb 8.75 oz
February 21, 2014	128.55	4 ft 2.61 in	24.48–25.74	53 lb 15.49 oz - 56 lb 2.11 oz
March 21, 2014	129.12	4 ft 2.84 in	25.04–26.09	55 lb 3.39 oz - 57 lb 8.33 oz
April 21, 2014	129.74	4 ft 3.08 in	25.65–27.44	56 lb 9.05 oz - 60 lb 7.97 oz
May 21, 2014	130.31	4 ft 3.30 in	26.22–28.27	57 lb 13.08 oz - 62 lb 5.46 oz

*Estimated adult reference height is equal to adult mid-parental (target) height (162.975 cm) in this particular case.
**First row represents values at the most recent checkup, which are taken as a reference to generate six-monthly recommendations.

Table 5: *Time slots for the city of Karachi, Pakistan, for full-body sun exposure of HrS*[4] *during the 6-month period following her last* (*third*) *checkup to obtain the required doses of vitamin D*

Date / Period	Safe*	Intermittent**	Prohibited	Intermittent	Safe
December 1	7: 00–8: 04	8: 05–9: 09	9: 10–15: 32	15: 33–16: 37	16: 38–17: 42
December 15	7: 09–8: 13	8: 14–9: 18	9: 19–15: 35	15: 36–16: 40	16: 41–17: 45
January 1	7: 17–8: 20	8: 21–9: 24	9: 25–15: 46	15: 47–16: 50	16: 51–17: 54
January 15	7: 19–8: 23	8: 24–9: 28	9: 29–15: 54	15: 55–16: 59	17: 00–18: 04
February 1	7: 15–8: 21	8: 22–9: 28	9: 29–16: 03	16: 04–17: 10	17: 11–18: 17
February 15	7: 07–8: 15	8: 16–9: 24	9: 25–16: 08	16: 09–17: 17	17: 18–18: 26
March 1	6: 55–8: 11	8: 12–9: 28	9: 29–16: 00	16: 01–17: 17	17: 18–18: 34
March 15	6: 41–7: 53	7: 54–9: 06	9: 07–16: 15	16: 16–17: 28	17: 29–18: 41
April 1	6: 24–7: 38	7: 39–8: 53	8: 54–4: 18	16: 19–17: 33	17: 34–18: 48
April 15	6: 10–7: 26	7: 27–8: 43	8: 44–4: 20	16: 21–17: 37	17: 38–18: 54
May 1	5: 56–7: 15	7: 16–8: 35	8: 36–4: 22	16: 23–17: 42	17: 43–19: 02
May 15	5: 48–7: 08	7: 09–8: 29	8: 30–4: 27	16: 28–17: 48	17: 49–19: 09

*Safe-exposure duration is when the sun has not reached 18° after rising or is at an angle less than 18° before setting; children may be exposed to direct sunlight (suitable for summer months).
**Intermittent-exposure duration is when the sun is at an angle between 18° and 36° after rising or between 36° and 18° (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 in Kamal & Khan (2020*a*).

[4] 10-15-*minute* guarded-graduated sun exposure (Kamal & Khan, 2018). HrS barefooted, bareheaded, dressed in underpants only (all clothing above the waist removed), hair opened up, eyes protected through UV-cutoff glasses, engaged in light exercises/free play; if sitting for drawing, jigsaw puzzles, painting, singing, story-telling/listening, her back should be towards the sun.

Table 2b lists height and mass targets for HrS for the next six months computed on the basis of Roadmap 2.5. One may be interested in comparing this table with Table 2b in Kamal, Ansari, Sarwar & Naz (2017), which lists the values based on Roadmap 1.1. Life-style adjustment, diet, and exercise plans have been prepared to help the children achieve these targets (Kamal et al., 2020a, Additional File 5).

To evaluate the percentage of females and males satisfying the induction criteria, CDC percentiles of height of all students were computed using the mathematical-statistical technique of box-interpolation (Kamal et al., 2011), employing Extended Growth Charts and Tables (Kamal & Jamil, 2014, Additional File 3). Regular CDC Growth Charts and Tables could not be used to compute CDC percentiles of army cut off height for males as it fell below 3rd percentile. These were arranged in ascending order, and the numbers of females and males having percentiles equal to or above the cut-off percentile were counted to determine the percentage of each gender satisfying the induction criteria.

Scaled percentiles of height were generated by fitting parabolic curve, which mapped CDC percentile 40 to scaled percentile 50 (Kamal, Azeemi & Khan, 2017). Scaled percentiles are considered to represent the growth of Pakistani children better. In addition, the postures and gaits (walking and running) of students were scrutinised for knees touching, knees knocking and toes inward/outward; also, the spinal columns were meticulously checked to find scoliosis cases (Kamal, Raza & Sarwar, 2020).

Results

Figure 3 gives the percentage of females and males fulfilling the induction criteria: 796 out of 1,163 (68.44%) females and 475 out of 503 (94.43%) males were up to the mark for induction into the Armed Forces of Pakistan based on their estimated adult heights.

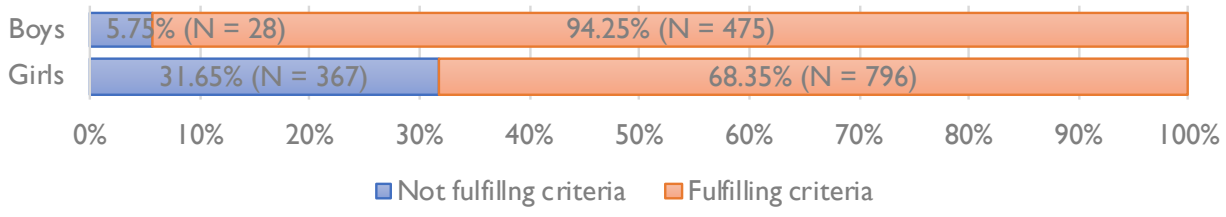


Figure 3: *Percentage of females and males fulfilling the criteria of induction into the Armed Forces of Pakistan; the analysis is based on cut off CDC percentiles 19.36 (females) and 2.72 (males)*

Discussion

This paper demonstrated a method to generate estimated adult height from computed CDC percentile of height for a student at any age. Participation in vigorous physical activity, in particular, organised sport, for example, gymnastics, tennis and football (Kamal & Khan, 2020b; Kamal, Khan & Aslam, 2020), should not only develop the student emotionally and socially but also help the individual pick up height.

The percentile corresponding to cut-off height for females has been set much higher than the corresponding percentile for males, making it tougher for the females to qualify for service in the Armed Forces of Pakistan. In this paper, the percentages of females and males eligible for induction are computed using mathematical-statistical techniques. The percentage of females came out to be significantly lower as compared to the corresponding percentage for males. There is a dire need to establish fairer criteria, which make the percentages of females and males who qualify for military and paramilitary occupations the same. This should give both genders equal opportunity to be selected and inducted into the Armed Forces of Pakistan.

Conclusion

The paper described the importance of generating estimated adult heights for younger males and females in order to provide sufficient time for the requisite corrections to be made so that these individuals are able to attain the required height by their early twenties to qualify for enlistment in the Armed Forces of Pakistan. The problem may be compared to the problem of guidance, navigation and control of a targeted spacecraft, where the course of the spacecraft is planned (guidance trajectory). On-board sensors on the spacecraft determine the current position and velocity (navigational trajectory). If the navigational trajectory is different from the guidance trajectory, a control action is initiated to correct the course of the spacecraft. It is preferred to accomplish maximum correction earlier during the course of flight (in the boost phase) in order to achieve the best results.

Based on the data presented and analysed in this paper, only 68.44% of females passed the induction criteria, whereas 94.43% of males were eligible for military and paramilitary occupations in Pakistan. Induction criteria in the Armed Forces of Pakistan for still-growing females and males should be fixed in such a way to provide both sexes with the same opportunity of being qualified based on their CDC (scaled) height percentiles, instead of their measured heights at the time of reporting to the selection centres.

Declaration of conflicting interests

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

Author contributions

SAK was responsible for conceptual design, data collection, data processing, generation of results, writing of the paper and overall supervision, AAN compiled data, constructed Growth-and-Obesity Vector-Roadmap 2.5 and prepared tables as well as figures.

References

Bailey, R. E., Hatton, T. J., & Inwood, K. (2016). Health, height, and the household at the turn of the twentieth century. *The Economic History Review*, *69*(1), 35-53. doi: https://doi.org/10.1111/ehr.12099

Banjevic, B. (2020). Morphological and functional characteristics of army recruits and professional soldiers of montenegro armed forces. *Journal of Anthropology of Sport and Physical Education*, *4*(1), 25-32. doi: https://doi.org/10.26773/jaspe.200104

Baten, J., & Blum, M. (2012). Growing tall but unequal: new findings and new background evidence on anthropometric welfare in 156 countries, 1810-1989. *Economic History of Developing Regions*, *27*(sup-1), 66-85.

Bozzoli, C., Deaton, A., & Quintana-Domeque, C. (2008). Adult height and childhood disease. *Demography*, *46*(4), 647-669. doi: https://doi.org/10.1353/dem.0.0079

Capocasa, M., Fytanidis, G., Masedu, F., & Danubio, M. E. (2019). Height trends in males and females from the island of Crete and its prefectures at the turn of the 20th century. *Anthropological Notebooks*, *25*(3). 41-53.

Dāboliņa, I., Viļumsone, A., & Lapkovska, E. (2017, June). Anthropometric parametrization of uniforms for armed forces. In Environment. Technologies. Resources. Proceedings of the International Scientific and Practical Conference (Vol. 3, pp. 41-46).

Georgiadis, E., Aliferis, C., Papandreou, L., Mantzoros, C., & Trichopoulos, D. (1993). Body height, weight and obesity in young Greeks. *Iatriki (Greek)*, *63*, 272-276.

Haq, M. Z., Iqbal, A., Afzal, A., Ahmad, H., Abbas, S., & Yaqoob, M. (2019). Anthropometric characteristics and physical fitness of urban and rural 8-10 years old school girls of Bahawalpur, Pakistan. *International Journal of Physiotherapy, 6*(2), 46-51.

Kamal, S. A. (2016). *Manual for obtaining Aanthropometric measurements.* The NGDS-Pilot-Project-e-Publication. Karachi.

Kamal, S. A., Azeemi, H. I., & Khan, S. R. (2017). 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.

Kamal, S. A., Ansari, M. J., Ansari, S. A., & Naz, A. A. (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 (Karachi)*, *17*(1), 23-57.

Kamal, S. A., Jamil, N., & Khan, S. A. (2011). Growth-and-Obesity Profiles of children of Karachi using box-interpolation method. *International Journal of Biology and Biotechnology*, *8*(1), 87-96.

Kamal, S. A., & Jamil, S. S. (2014). KJ-regression model to evaluate optimal masses of extreme cases. *International Journal of Biology and Biotechnology, 11*(4), 623-648.

Kamal, S. A., Jamil, S. S., & Razzaq, U. A. (2014). Stunting induced by wasting—wasting induced by stunting: A case study. *International Journal of Biology and Biotechnology*, *11*(1), 147-153.

Kamal, S. A., & Khan, S. A. (2018). Overcoming vitamin-D deficiency in male gymnasts during preteen years. *The Sky - International Journal of Physical Education, Health and Sports Sciences, 2,* 60-75.

Kamal, S. A., & Khan, S. A. (2020a). 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,* 119-47.

Kamal, S. A., & Khan, S. A. (2020b). Operation of sport academies during and after corona pandemic. *Uluslararası Beden Eğitimi Spor ve Teknolojileri Dergisi*, *1*(2), 12-29.

Kamal, S. A., Khan, S. A. & Aslam, S. (2020). A model football academy for residents of Lyari Town, Karachi, Sindh, Pakistan. *The Sky - International Journal of Physical Education, Health and Sports Sciences, 4,* 5-38.

Kamal, S. A., Ansari, S. A., Sarwar, M., & Naz, A. A. (2017). Medical criteria for induction into the Armed Forces of Pakistan: Cutoff heights for still-growing youth. *International Journal of Biology and Biotechnology*, *14*(3), 319-331.

Kamal, S. A., Raza, S. K., & Sarwar, M. (2020). Effectives of proposed risk indicators in scoliosis case finding. *International Journal of Biology and Biotechnology (Karachi)*, *17*(3), 517-530.

Karpinos, B. D. (1958). Height and weight of selective service registrants processed for military service during World War II. *Human Biology*, *30*(4), 292-321.

Karpinos, B. D. (1961). Current height and weight of youths of military age. *Human Biology*, *33*(4), 335-354.

Papadimitriou, A., Fytanidis, G., Douros, K., Papadimitriou, D. T., Nicolaidou, P., & Fretzayas, A. (2008). Greek young men grow taller. *Acta Paediatrica*, 97(8), 1105-1107. doi: https://doi.org/10.1111/j.1651-2227.2008.00855.x

Shafqat, N., Manzoor, S., & Abbasi, S. (2013). Relationship of Sociodemographic Factors with Malnutrition in Preschool Children: A Community Based Study. *Pakistan Journal of Medical Research*, *52*(4), 120-125.

Povzetek

Članek analizira merila za še vedno rastoče mlade (ženske do 19 let; moški do 21 let) za vključitev v oborožene sile Pakistana, da bi ugotovili, ali imajo posamezniki glede na spol enake možnosti vključitve. Izmerjena je bila višina 1.666 otrok (1.163 žensk; 503 moških), vpisanih v pakistanske šole (vojaške in civilne). Za zbiranje podatkov je bilo uporabljeno praktično vzorčenje. Odstotek žensk in moških, ki izpolnjujejo pogoje za vojaško službo, je bil določen z izračunom njihove ocenjene višine v odraslosti. Mejna višina za vključitev v pakistanske oborožene sile je 157,48 cm za ženske in 162,56 cm za moške, kar ustreza CDC (skaliranim) centilom višine 19,36 (25,86) za ženske in 2,72 (3,82) za moške. Analiza je pokazala, da je pogojem za vojaško službo ustrezalo 68,44 % žensk in 94,43 % moških. Mejni CDC (skalirani) centil za vključitev žensk je višji od centila za moške. Na podlagi mejnih vrednosti višine je odstotek žensk, ki izpolnjujejo pogoje za izbor v oborožene sile Pakistana, bistveno nižji od ustreznega odstotka moških. Zato je treba vzpostaviti ustrezne kriterije, ki bi kvalificirali enak odstotek žensk in moških za tovrstne poklice.

KLJUČNE BESEDE: ocenjena višina odrasle osebe, upravljanje višine in mase, optimalna masa, centil

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