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Original research article

Evaluation of growth chart use among clinicians in Saudi Arabia: Is there a need for change?

Rana H. Mosli

Clinical Nutrition Department, Faculty of Applied Medical Sciences, King Abdulaziz University, P.O. Box 80215, Jeddah 21589, Saudi Arabia

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ABSTRACT

Objective: To identify types of growth charts and practices employed by clinicians to assess pediatric patients in Saudi Arabia; To assess clinicians' interpretation and comprehension of growth charts.
Methods: This is a Cross-sectional study including 105 pediatricians and dietitians residing in Saudi Arabia. Participants completed an online questionnaire which assessed: region of residence, work facility, typical practices in pediatric patient assessment, and ability to correctly interpret and comprehend growth chart data. Data were analyzed using descriptive and chi-square statistics.
Results: Majority of respondents (70.5%) reported typically using either the CDC or WHO growth charts. Only 52.4% reported always using growth charts and discussing weight status of pediatric patients during annual/regular visits, and 54.3% reported discussing the patient's weight status with his/her caregiver(s) under all circumstances. Only 23.8% correctly answered the interpretation question, while 50.5% correctly answered the comprehension question. A higher percentage of clinicians residing in the Southern, Central, and Western regions reported that they always or often discuss the patient's weight status with his/her caregiver(s) (100%, 89.2% and 81.4%, respectively) (P value = 0.004). Clinicians who worked in private hospitals only, and who typically used the Saudi growth charts were least likely to report that they always or often discuss the patient's weight status with his/her caregiver(s) (50% and 61.5%, respectively) (All *Ps* < .05).
Conclusion: Growth chart utilization among clinicians in Saudi Arabia needs further evaluation. Clinicians residing in the Northern and Eastern regions, who worked in private hospitals only, and who typically used the Saudi growth charts showed poorer practices with regards to growth chart utilization.

1. Introduction

Growth charts are tools used to assess children's growth and well-being; Clinicians use growth charts to evaluate children's nutritional status, and prescribe any necessary medical or nutritional interventions when a growth problem is detected [1]. A growth chart consists of a series of curves of a specific body measurement (weight, length/height, or head circumference) [2] that represent selected percentiles of a reference population [2]. Using a growth chart enables one to compare a child's growth parameters to those of a large group of children of the same age and sex [2]. Accurately plotting a body measurement on a growth chart can be useful for screening children for malnutrition, and repeated plotting over time enables monitoring of growth patterns and growth velocity [3,4]. For example, if a child's length/height for age falls below a specific percentile, this might indicate stunting, while a high weight for length/height that is plotted above a certain percentile might indicate obesity [5]. Nonetheless, accelerated downward or upward crossing of percentiles might suggest an abnormal growth velocity, and may signal medical or nutritional problems such as failure to thrive, increased obesity risk or presence of an endocrine disorder [4,6].

Growth charts have been developed by both international organizations, such as the World Health Organization (WHO) [7] and the International Obesity Task Force (IOTF) [8], and by country-specific governmental agencies, such as the Centers for Disease Control and Prevention (CDC) in the United States [2]. In 2007, growth charts were developed in Saudi Arabia using a Saudi reference population [9]. Although all growth charts were

E-mail address: aimuwseli@kau.edu.sa.
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developed based on reference populations comprising of healthy children, rigorousness of the selection criteria varied for each [7–9]. Furthermore, with the exception of the Saudi growth charts, each growth chart is accompanied by evidence-based criteria for defining child weight status based on percentile cut-offs. Some of these criteria were validated by examining correlations with body fatness. For example, the CDC's percentile cut-off for obesity (i.e., sex-specific BMI for age ≥95th percentile) was found to be a "moderately sensitive and a specific indicator of excess adiposity among children" [10]. However, the sensitivity of the IOTF criteria for defining obesity was found to be poor when correlated with percentage of body fat [11]. Additionally, some growth charts are accompanied by tools/instructions that allow the conversion of percentiles into z-scores, which is useful for research purposes by allowing for calculations of summary statistics (e.g., mean and standard deviation of BMI-for-age z-score in a study sample) [1,5].

As discussed above, different growth charts vary in the way they were developed and in their method of utilization. Because clinicians may have different training backgrounds, and may favor one growth chart over the other, a discrepancy may be observed in types of growth charts used within a single country if a clear recommendation/guideline was not established. In the United States, the CDC and the American Academy of Pediatrics (AAP) recommend all practitioners to use the WHO growth charts for all children from birth to up to 2 years of age, and the CDC growth charts for children and adolescents aged 2–19 years [12]. On the other hand, in Saudi Arabia, no clear consensus exists regarding the most suitable/appropriate growth chart to be used; Clinicians have no standard protocol to follow for assessing children's growth. This is concerning because of two main points: 1) Studies have shown evidence of significant discrepancies in child growth assessment findings when one growth chart is used vs. the other (e.g., children more likely to be classified as stunted or underweight if the CDC vs. the Saudi growth chart was used) [13], which can lead to conflicting medical/nutritional interventions when different clinicians are consulted within the same area/health care center; 2) Obesity rates in the Kingdom continue to be alarmingly high [14], and misuse of growth charts or inadequate monitoring of children's growth can mitigate efforts of combating this epidemic at the population level.

Despite the urgency of evaluating the use of growth charts among clinicians in Saudi Arabia, we were unable to identify any studies that assessed the type of growth charts commonly used and the practices followed for assessing children's growth in the Kingdom. Thus, the primary objective of this study was to identify the types of growth charts and practices commonly employed by pediatricians and clinical dietitians in Saudi Arabia and to assess the clinicians' interpretation and comprehension of growth charts. Findings from this study can be used for identification of areas of improvements in growth chart use and can inform recommendations for child growth assessment and monitoring.

2. Materials and methods

2.1. Sample and procedure

The study sample included 105 clinicians (i.e., pediatricians and clinical dietitians) who were recruited by completing an online questionnaire. The link for the questionnaire was circulated through various social media outlets (mainly Twitter and Facebook) and was posted by 2 popular Saudi public figures. The link was also posted on webpages of associations/society groups for Saudi pediatricians and clinical dietitians. Instructions for completing the survey included that the respondent must be a practicing general pediatrician or clinical dietitian who is currently working in Saudi Arabia. A statement of anonymity and confidentiality was included. Ethical approval for this study was obtained from King Abdulaziz University Faculty of Applied Medical Sciences Ethics and Research Committee.

2.1.1. Measures

Participants completed the 9-item questionnaire, which included questions about:1) The respondent's profession (pediatrician vs. clinical dietitian); 2) Respondent's region of residence in Saudi Arabia (Western, Central, Eastern, Southern, or Northern region); 3) Respondent's work facility (government hospital only, private hospital only, private practice only, government and/or private hospital and private practice); 4) The type of growth chart that the respondent typically uses for assessing pediatric patients (CDC growth chart, WHO growth chart, Saudi growth chart, IOTF growth chart); 5) Frequency at which the respondent uses growth charts to assess pediatric patient's growth during annual/regular check-ups (always, often, sometimes, rarely, never); 6) Frequency at which the respondent discusses pediatric patient's weight status with his/her caregiver(s) during annual/regular check-ups (always, often, sometimes, rarely, never); 7) Circumstances under which the respondent discusses pediatric patient's weight status with his/her caregiver(s) (under all circumstances, if the child was normal-weight only, if the child was underweight or obese only, if the child was underweight, overweight, or obese); 8) The respondent's ability to correctly interpret growth chart data, which was assessed by asking "A 1-year old patient is definitely overweight if: His length-for-age is high, his weight-for-age is high, both his weight-for-age and length-for age are high, none of the above, I don't know". Response options for this variable were later collapsed into 3 categories only: "correct" (representing an answer of "none of the above"), "incorrect", and "does not know"; 9) The respondent's comprehension of the growth chart, which was assessed by asking "The average BMI among children of a specific age is represented by: The 80th percentile on the BMI-for age growth chart, the 80th percentile on the weight-for-length growth chart, the 50th percentile on the BMI-for-age growth chart, the 50th percentile on the weight-for-length growth chart, I don't know". Response options for this variable were later collapsed into 3 categories only: "correct" (representing an answer of "50th percentile on the BMI-for-age growth chart"), "incorrect", and "does not know". In order to establish content validity, 3 experts were asked to review the questionnaire and rate each item based on relevance, clarity, ambiguity, and simplicity on a 4-pont scale. Content Validity Index (CVI) exceeded 0.75 for all items and were therefore retained in the questionnaire [15].

2.2. Statistical analysis

Analyses were conducted using IBM SPSS Statistics 21.0 (Armonk, NY, USA). Descriptive statistics were used to assess characteristics and practices (i.e., region of residence, work facility, growth chart use, interpretation, and comprehension) of the total sample, and by profession (pediatrician vs. clinical dietitian). Differences in characteristics and practices between pediatricians and clinical dietitians were examined by Chi-square statistics.

In order to further assess correct utilization of growth charts by clinicians, we later created additional dichotomous variables for: 1) Always or often uses growth charts for assessment during annual/regular check-up; 2) Always or often discusses weight status with caregiver(s) during annual/regular check-up; 3) Discusses weight status with caregiver(s) under all circumstances; 4) Correct interpretation and comprehension of growth charts (defined as answering correctly on both the interpretation and comprehension questions). Using Chi-square statistics, we then examined the association of profession, region of residence, work facility, and type

of growth chart typically used with each of the dichotomous variables outlined above (representing correct utilization of growth charts).

3. Results

3.1. Sample characteristics and practices and differences by profession

As shown in Table 1, 39% of the sample reported that they were pediatricians and 61% reported that they were clinical dietitians. The majority resided in the Western (41%) and Central (35.2%) regions, which are the most densely populated regions in Saudi Arabia. Most participants (71.4%) reported that they work in government hospitals only, and the majority typically used the CDC or WHO growth charts (40% and 30.5%, respectively). Only about half of the sample (52.4%) reported that they always use growth charts and discuss the weight status of pediatric patients during annual/regular check-ups. In addition, only about half of the sample (54.3%) reported that they discuss the patient's weight status with his/her caregiver under all circumstances. Only 23.8% correctly answered the question assessing growth chart interpretation, while half (50.5%) correctly answered the question assessing growth chart comprehension. There were no significant differences between pediatricians and clinical dietitians on any of the characteristics or practices (All *Ps* > .05).

3.2. Associations with correct utilization of growth charts

Further analyses revealed a trend of an association between profession and correct interpretation and comprehension of growth charts; More clinical dietitians (17.2%) compared to pediatricians (4.90%) correctly answered both questions assessing growth chart interpretation and comprehension ($P < .10$). A higher percentage of clinicians who were residents of the Southern, Central, and Western regions reported that they always or often discuss the patient's weight status with his/her caregiver(s) during annual/regular check-ups (100%, 89.2% and 81.4%, respectively) ($P < .01$). On the other hand, clinicians who worked in private hospitals only, and those who typically used the Saudi growth charts were least likely to report that they always or often discuss the patient's weight status with his/her caregiver(s) during annual/regular check-ups (50% and 61.5%, respectively) (All *Ps* < .05). There was a trend of an association between work facility and always or often using growth charts for assessing pediatric patients during annual/regular check-ups; A higher percentage of clinicians working in

Table 1
Characteristics and practices of total sample and differences by profession.

	Total Sample N = 105	Pediatricians N = 41 (39%)	Clinical Dietitians N = 64 (61%)	*P* value
Region of Residence, n (%)				
Western Region	43.0 (41.0)	20.0 (48.8)	23 (35.9)	.40
Central Region	37.0 (35.2)	14.0 (34.1)	23 (35.9)	
Eastern Region	17.0 (16.2)	6.00 (14.6)	11 (17.2)	
Southern Region	4.00 (3.80)	0.00 (0.00)	4.00 (6.30)	
Northern Region	4.00 (3.80)	1.00 (2.40)	3.00 (4.70)	
Work Facility, n (%)				
Government hospital only	75.0 (71.4)	34.0 (82.9)	41.0 (64.1)	.18
Private hospital only	8.00 (7.60)	2.00 (4.90)	6.00 (9.40)	
Private practice only	7.00 (6.70)	1.00 (2.40)	6.00 (9.40)	
Government and/or private hospital and private practice	15.00 (14.3)	4.00 (9.80)	11.00 (17.2)	
Type of Growth chart typically used, n (%)				
CDC growth chart	42.0 (40.0)	15.0 (36.6)	27.0 (42.2)	.73
WHO growth chart	32.0 (30.5)	12.0 (29.3)	20.0 (31.2)	
Saudi growth chart	26.0 (24.8)	11.0 (26.8)	15.0 (23.4)	
IOTF growth chart	5.00 (4.80)	3.00 (7.30)	2.00 (3.10)	
Frequency of growth chart use for assessment during annual/regular check-up, n (%)				
Always	55.0 (52.4)	23.0 (56.1)	32.0 (50.0)	.47
Often	18.0 (17.1)	7.00 (17.1)	11.0 (17.2)	
Sometimes	26.0 (24.8)	7.00 (17.1)	18.0 (28.1)	
Rarely	5.00 (4.80)	3.00 (7.30)	2.00 (3.10)	
Never	1.00 (1.00)	0.00 (0.00)	1.00 (1.60)	
Frequency of discussing weight status with caregiver(s) during annual/regular check-up, n (%)				
Always	55.0 (52.4)	19.0 (46.3)	36.0 (56.3)	.28
Often	27.0 (25.7)	14.0 (34.1)	13.0 (20.3)	
Sometimes	15.0 (14.3)	6.00 (14.6)	9.00 (14.1)	
Rarely	4.00 (3.80)	2.00 (4.90)	2.00 (3.10)	
Never	4.00 (3.80)	0.00 (0.00)	4.00 (6.30)	
Circumstances under which the child's weight status is discussed with caregiver(s), n (%)				
Under all circumstances	57.0 (54.3)	22.0 (53.7)	35.0 (54.7)	1.00
If the child was normal-weight only	2.00 (1.90)	1.00 (2.40)	1.00 (1.60)	
If the child was underweight or obese only	8.00 (7.60)	3.00 (7.30)	5.00 (7.80)	
If the child was underweight, overweight, or obese	38.0 (36.2)	15.0 (36.6)	23.0 (35.9)	
Answer to growth chart interpretation question, n (%)				
Correct	25.0 (23.8)	7.00 (17.1)	18.0 (28.1)	.43
Incorrect	72.0 (68.6)	31.0 (75.6)	42.0 (65.6)	
Does not know	8.00 (7.60)	3.00 (7.30)	4.00 (6.30)	
Answer to growth chart comprehension question, n (%)				
Correct	53.0 (50.5)	16.0 (39.0)	25.0 (39.1)	.50
Incorrect	44.0 (41.5)	11.0 (26.8)	23.0 (35.9)	
Does not know	8.00 (7.60)	14.0 (34.1)	16.0 (25.0)	

CDC, Centers for Disease Control and Prevention. WHO, World Health Organization, IOTF. International Obesity Task Force.
Table showing counts (*n*) and percentages (%).
Significant differences between profession groups tested by Chi-square statistic.

government hospitals only (76%) reported employing this practice ($P < 0.10$) (Table 2).

4. Discussion

We found that the majority of pediatricians and clinical dietitians in Saudi Arabia used either the CDC or the WHO growth charts, and that a small proportion (about one quarter) used the Saudi growth charts. Only about half of the sample reported that they always use growth charts to assess patients during annual/regular check-ups and that they always discuss the patient's weight status with his/her caregiver(s). Likewise, only about half reported that they discuss the patient's weight status with his/her caregiver(s) under all circumstances (i.e., with any weight status). This finding is concerning, given the importance of thorough assessment and close monitoring of growth during childhood, especially in populations at high risk for obesity and nutritional problems [16,17]. The American Academy of Pediatrics recommends the use of growth charts to assess children's growth at every well-child (i.e., annual) visit [18]. The child's growth parameters should be discussed with his/her parents and percentiles should be presented and explained regardless of normality or lack of it [19]. In fact, recently, the role of growth charts has expanded from being a tool used exclusively by clinicians, to being an instrument that is also frequently used by parents at home to track their children's growth and identify any problems at early stages [19,20].

In order for clinicians to correctly transmit growth chart information to parents, they must first exhibit consistent and correct utilization of these growth chart, and be able to correctly interpret and comprehend its data. Our findings suggest that growth chart interpretation and comprehension by clinicians in Saudi Arabia is far from ideal; Only about a quarter of the sample correctly answered the interpretation question and about half correctly answered the comprehension question. Clinical dietitians appeared to do better than pediatricians in answering the interpretation and comprehension questions, although the difference between the two groups only approached statistical significance. Clinicians residing in the Northern and Eastern regions, those who worked in private hospitals only, and those who typically used the Saudi growth charts showed poorer practices with regards to growth chart utilization.

Growth chart use among the groups mentioned above may be enhanced by targeted workshops and educational and training sessions. Future studies that include qualitative data may be useful in identifying barriers to consistent and correct utilization of growth charts, and interventions may be informed by their findings. Furthermore, additional studies are needed in order to investigate the reasons behind the low utilization of the Saudi growth charts. It is plausible that the limitations of the currently available Saudi growth charts outweigh its strengths. Further studies are needed in order determine whether revisions to the currently available Saudi growth charts are required.

To our knowledge, this is the first study that has evaluated growth chart use among clinicians in Saudi Arabia. In addition, we expanded our evaluation to also assessing interpretation and comprehension of growth charts and have examined associations with characteristics and practices. However, like most cross-sectional studies, ours in not without limitations. First, our sample size is small. Although we were able to recruit clinicians from all over the Kingdom, our small sample size may have affected our statistical power and ability to detect significant associations. Furthermore, our study included an online questionnaire, and in order to enhance the response rate, we only included 9 questions to reduce respondent burden. There may be other important factors relating to growth chart utilization, such asyears of practice and educational background, that were not examined in this study. Future efforts may include additional measures of interest.

Table 2
Association of profession, region of residence, work facility, and type of growth chart typically used with correct utilization of growth charts.

	Always or often uses growth charts for assessment during annual/regular check-up	Always or often discusses weight status with caregiver(s) during annual/regular check-up	Discusses weight status with caregiver(s) under all circumstances	Correct interpretation and comprehension of growth charts
Profession				
Pediatrician	30.0 (73.2)	33.0 (80.5)	22.0 (53.7)	2.00 (4.90)
Clinical Dietitian	43.0 (67.2)	49.0 (76.6)	35.0 (54.7)	11.0 (17.2)
P value	.66	.81	1.00	.07$^{\tau}$
Region of Residence				
Western Region	28.0 (65.1)	35.0 (81.4)	25.0 (58.1)	6.00 (14.0)
Central Region	29.0 (78.4)	33.0 (89.2)	21.0 (56.8)	7.00 (18.9)
Eastern Region	9.00 (52.9)	8.00 (47.1)	7.00 (41.2)	0.00 (0.00)
Southern Region	4.00 (100)	4.00 (100)	1.00 (25.0)	0.00 (0.00)
Northern Region	3.00 (75.0)	2.00 (50.0)	3.00 (75.0)	0.00 (0.00)
P value	.21	.004**	.46	.27
Work Facility				
Government hospital only	57.0 (76.0)	64.0 (85.3)	44.0 (58.7)	10.0 (13.30)
Private hospital only	3.00 (37.5)	4.00 (50.0)	1.00 (12.5)	1.00 (12.50)
Private practice only	4.00 (57.1)	5.00 (71.4)	4.00 (57.1)	1.00 (14.30)
Government and/or private hospital and private practice	9.00 (60.0)	9.00 (60.0)	8.00 (53.3)	13.00 (6.70)
P value	.09$^{\tau}$	.03*	.10	.91
Growth chart typically used				
CDC growth chart	34.0 (81.0)	37.0 (88.1)	25.0 (59.5)	5.00 (11.9)
WHO growth chart	20.0 (62.5)	24.0 (75.0)	17.0 (53.1)	4.00 (12.5)
Saudi growth chart	16.0 (61.5)	16.0 (61.5)	13.0 (50.0)	3.00 (11.5)
IOTF growth chart	3.00 (60.0)	5.00 (100)	2.00 (40.0)	1.00 (20.0)
P value	.22	.04*	.78	.96

CDC, Centers for Disease Control and Prevention. WHO, World Health Organization, IOTF. International Obesity Task Force.
Associations between variables tested by Chi-square statistic.
τ $P < 0.10$, $^{*}P < 0.05$, $^{**}P < 0.01$.

5. Conclusion

Growth chart utilization among pediatricians and clinical dietitians in Saudi Arabia is not ideal, and needs further evaluation. Interventions addressing this issue may include targeted training and educational workshops. Given the rise of obesity rates and nutritional problems in the Kingdom [14], efficient utilization of growth charts by clinicians is needed for proper monitoring of growth and weight status.

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Conflicts of interest

The authors have no conflicts of interest to disclose.

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