ORIGINAL ARTICLE
Novel Methodology for the Selection of Cases from MICS data for Growth Charts Development Based on WHO Criterion

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ABSTRACT

Background: The growth charts are very important for monitoring a child growth and for estimation of stunting and wasting in a country. This can be done efficiently if the references and standards for growth monitoring are correct.
Aim: To devise the methodology of selection of cases from multiple indicator cluster survey (MICS) data available worldwide under UNICEF for most of the developing and non-developed countries.
Methods: This methodology was devised during 1st January 30th June 2022 in College of Statistical Sciences, University of the Punjab, Lahore. The three rounds of MICS, i.e. the 4th, 5th and 6th, were evaluated for their eligibility to develop a standard growth chart for children under two year's age. The criteria needed to be met were, singleton, full term birth up to 4thorder, exclusive breastfeeding for 4-6 months, continuing breastfeeding till one year age. Belonging to affluent socioeconomic status, not having any severe illness and born to non-smoking mothers. The MICS data is available in the format of SPSS data files. These files have been explored for the variables answering these questions directly or indirectly.
Results: The MICS rounds 4 and 5 were discarded after having a detailed view, as they were not fulfilling the WHO criteria due to missing information for several important variables. The round 6 was found to have direct information on many of the variables, i.e., singleton, full-term, birth order, family size, mother smoking status while some other variables i.e. exclusive breast feeding, severe illness, and not belonging to deprived class were objectively created using some other variables existing in MICS data
Conclusion: This methodology for selection of cases, can provide us children with height, weight, age and gender of children as per WHO criteria required to meet for development of the standard growth chart for children under two years age.
Keywords: WHO criteria, Pediatric growth standards, MICS

INTRODUCTION

The growth curves are important for estimation of different measures like, stunting and wasting, two important measures indicating malnourishment in any country. As per joint child malnutrition estimates (JCME), these are measured by comparing a child growth with the standard growth curves prepared by WHO. For stunting the child with weight <-2SD of WHO standards is considered stunted and the children on <-2SD for weight for height is considered wasted (JME, UNICEF-WHO-WB).[1]WHO growth standards developed in 2006 are the measuring tools, used in Pakistan[2,3]. Many studies have shown that the WHO standard curves are not very relevant to their real national growth pattern, and, for this very reason, more than 40 countries have developed their own standard/ reference curves. The standard curve for 0-24 months are of great importance, clinically the most important years to set the growth pattern for a child, and need very precise data[4].

The best method is to conduct a national survey with representative sample or to perform a longitudinal study with randomly selected children and following them for anthropometric measures through different intervals as done by WHO multicenter growth study.[3]The first option needs funds and the second needs not only funds but a sufficient time span.

The ready-to-go method suggested in this paper is to select a representative sample from the rounds of multiple indicator cluster survey (MICS) performed in Pakistan, as well as, worldwide in developing countries with the support of united nations international children emergency fund (UNICEF), provides robust data, also includes anthropometric measures[5]. The first question arose was whether it will be worth to collect sample through this method. The methodology of MICS surveys were studied thoroughly, for round 4, 5 and 6, and it was noticed that the round 6 of the survey had the most appropriate data for this purpose, not only for anthropometric measures, but had quite built-in variables for selection of conditions necessary to be followed when trying to develop standard curve[3].

The necessary conditions include full term birth, singleton, birth up to 4th order, no episode of severe illness

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during initial months of life and no chronic illness which can affect the growth, exclusive breast feeding for 4-6 months and continued till one year. Born to non-smoking mothers, living in non-congested house and not deprived of minimal required nutritional value food and basic necessities[3,5].

METHODOLOGY

The novel methodology devised and suggested here, is based on a comprehensive literature review, which justifies the all the steps of methodology. Firstly, it was observed that many countries have used their national surveys data for developing standard or reference growth curves which include China, Iran, Egypt, US, New Zealand, Netherlands and many others[4].

On examining the work done internationally on growth charts, regarding breast feeding practices, it was observed that China[6] and Poland[7] reported the general wellbeing of their populations, breastfeeding and exclusive breastfeeding rates and, having better socioeconomic status, well above poverty line[8] and hence did not exclude cases on these bases. In another study in Turkey, it was reported that the majority of one year age children currently being breastfed so breastfeeding was not considered for exclusion of cases while developing charts[9]. In India[10], the cases were selected from rounds of surveys on the basis of exclusive breast feeding in first six months. The height references developed for German kids were based on KIGGs data and considered the children of age 3 months and above only, so not considered breast feeding[11]. The Finish reference 0-20 years[12] considered WHO[3] criterion but exclusive breast feeding was also not considered. In Japan, their breast fed children were compared with WHO standards and their own national references and claimed significant differences, which shows the importance of breastfeeding factor in growth, specifically under 2 years' age[13]. Burren wrote a chapter in "Importance of growth for health and development" mentioning what might be the effects of selection of specific cases or dropped out cases, on growth estimates, on the basis of not following WHO strict criteria of compliance of exclusive breast feeding, and concluded that every population or country may need their own standards[14].

Fig. 1: *Weight at 2 years: 30 countries versus Multicentre Growth Reference Study (MGRS). The green box delimits the area within 0.5 SD of the MGRS mean. The green line within the box shows the MGRS mean. (A) Boys; MGRS mean: 12.2 kg; SD up: 1.55 kg, down: 1.25 kg. (B) Girls; MGRS mean: 11.5 kg; SD up: 1.65 kg, down: 1.25 kg. Error bars show 1 SE.(Source: Natale et al, 2014)* [4]
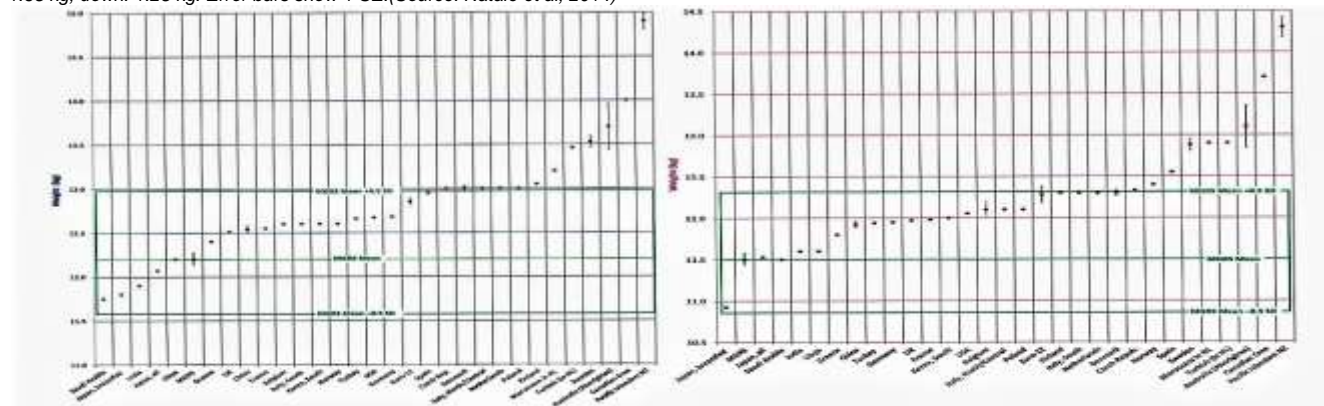

Table 1: Inclusion exclusion criteria used by Indian[10] study to develop national standard growth charts

Age	0-59 months for both sexes	
Non-twin	Single	
Birth interval	More than 24 months	
Size at birth	Average and above	
Birth order	Up to 4	
Child living in non-congestion house	<5 person in one house with separate kitchen	
Wealth index (proxy of income)	Higher wealth score for top deciles (which indicates richest)	
Health related		
Source of drinking water Safe water: is tap, hand pump/tube well, safe and covered well		Yes
Type of fuel used for cooking in household Electricity, natural gas/LPG or biogas		Yes
Infant feeding practices Exclusive breast feeding: At least 6 months since births		Yes
Smoking/tobacco/alcohol consumed by mother Nonsmoking		Yes

The full term singleton birth was almost considered by every study and underweight at birth were excluded by the references developed for Finland population[12] but the Indian[10] study, however, not excluded underweight for full term singleton birth as was done by WHO[3]. So far countries developed their own standards/reference growth charts are well ahead on Per Capita, GDP, Income and health expenditures, yet some are having their standard/reference for children with growth measures lower than WHO standards and some having higher (Figure 1)[4].

This again suggests that the growth is affected by the genetic and environmental factors too. So a methodology to develop standard growth chart is being worked and suggested based on round 6 of the MICS, with working on selection of cases to the nearest possible conditions imposed by WHO MCGS, which is also been adopted by the authors who developed Indians standards[10].

This Indian study merged three rounds of National Family and Health Survey (NFHS), 1992-93, 1998-99 and 2003-04 with an interval of almost 13 years and its inclusion criteria for standard growth chart development was as explained(table 1)[10]

RESULTS AND DISCUSSIONS

This section explains the outcome based on literature reviewed and decisions made on those basis for defining and justifying the methodology. The first decision was made on to use the data of national survey. For this the round 4, 5 and 6 of MICS conducted by Pakistan in partnership with UNICEF were thoroughly reviewed and a decision was made to include Round 6 only. In Pakistan the MICS is conducted by provinces separately and the round 6 in Punjab was conducted in 2017-18, In Sindh 2018-19, In KPK 2019 and in Balochistan 2019-20 under unique, similar methodology. This justifies the mixing up of these data sets with same variable name and same number of files which makes it a national representative sample. This methodology is universally adoptable, as the nature and pattern of data for MICS-6, conducted worldwide is same.[5]
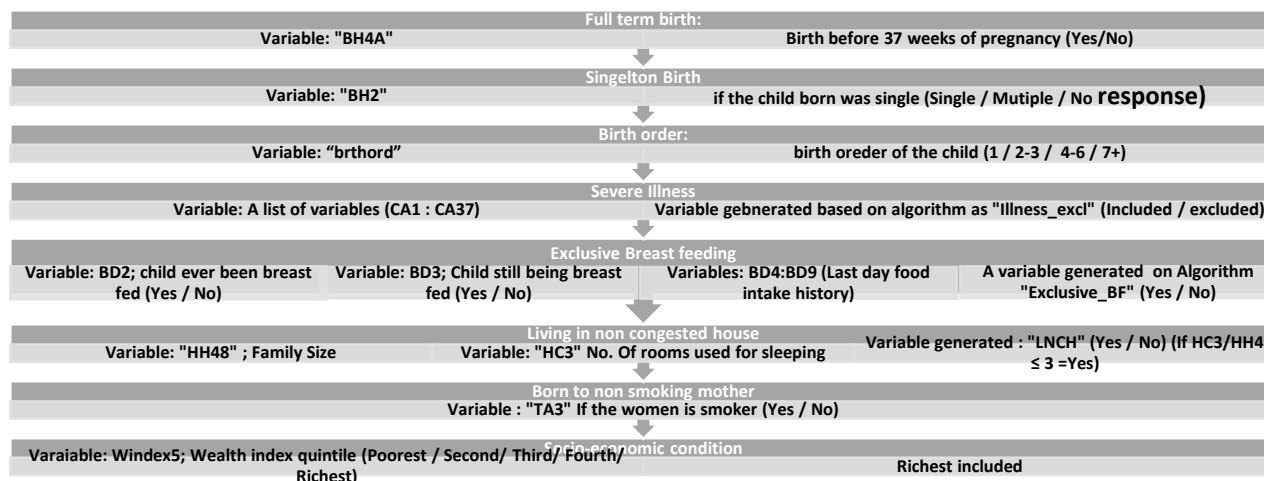
Fig. 2: Novel methodology enabling selection of cases for standard as per WHO criteria

Full term birth:	
Variable: "BH4A"	Birth before 37 weeks of pregnancy (Yes/No)

Singelton Birth	
Variable: "BH2"	if the child born was single (Single / Mutiple / No **response)**

Birth order:	
Variable: "brthord"	birth oreder of the child (1 / 2-3 / 4-6 / 7+)

Severe Illness	
Variable: A list of variables (CA1 : CA37)	Variable gebnerated based on algorithm as "Illness_excl" (Included / excluded)

Exclusive Breast feeding			
Variable: BD2; child ever been breast fed (Yes / No)	Variable: BD3; Child still being breast fed (Yes / No)	Variables: BD4:BD9 (Last day food intake history)	A variable generated on Algorithm "Exclusive_BF" (Yes / No)

Living in non congested house		
Variable: "HH48" ; Family Size	Variable: "HC3" No. Of rooms used for sleeping	Variable generated : "LNCH" (Yes / No) (If HC3/HH4 ≤ 3 =Yes)

Born to non smoking mother	
Variable : "TA3" If the women is smoker (Yes / No)	

Socio-economic condition	
Varaiable: Windex5; Wealth index quintile (Poorest / Second/ Third/ Fourth/ Richest)	Richest included

Table 2: Identification matching of variables before merging "ch", "bh" "hh"and"wm" files

Step	Primary File	Merged File 1	Merged File 2	Merged File 3
	File name: "ch" Contains children data	File name: "bh" contains birth history of the child	File name: "hh" contains all household information	File name: "wm" contains the smoking status of mothers
I	1. Variable "Province" added before merger as files were separate for each province and each province was assigned a code 2. Variable "Division" (Re-coded before merger) provincial codes were added as predecessor to the assigned divisional codes			
II	Appended for all four provinces on all common variables			
III	Variables decided for merging in each file and renaming of variables, where required, and data were sorted by these variable 1. Province 2. HH1 (Cluster no.) 3. HH2 (Household no)			
	LN (Children line no)Changed to BH8 in "ch"	4. BH8 (Children line no) in "bh"		
IV	Data merged for two files and the **Outcome1:** birth history of each child got attached with child on line number "BH8"			
V			Data sorted for "hh" ' file on 1. Province 2. HH1 (Cluster no.) 3. HH2(Household no)	
VI			Data merged by taking **outcome-1of step-IV** as primary and "hh" as secondary file **Outcome-2:** household information got attached with first child of the family included	
VII			Data sorted for women line number in **outcome-2**	Data sorted for "wm" ' file on variables at step-V& women line number in "hh" Only considered variable "TA3"
VIII				**Outcome-3** Mother's matching on women line number got attached on smoking status **Complete file for MICS-6 ready**

The Novel Methodology based on MICS6: The MICS survey data was first merged for 4 required files for the provinces, which include 'ch", "bh", "hh" and "wm" gathered for round 6 for Punjab, Sindh, KPK and Balochistan through UNICEF website.[15]

The final data file got ready in 8 steps. The step-I and II were to prepare national files for the four selected files i.e. "ch", "bh", "hh" and "wm" from each province and for this purpose matching of variables for each province was assured. In step-III, the one variable in "file ch" was renamed to ensure matching of "ch" and "bh" and data were sorting on identification variable. Step-IV produced outcome file resulted from merging of "ch" and "bh" named (**outcome-1**), then the household information was attached to the outcome-1 from file"hh" and was named (**outcome-2)** at step-VI. Finally the information on smoking of mothers was extracted from file"wn" by merging it into outcome-2 and a final file was obtained at step-VIII (Table 2).

Once the outcome-3 file was obtained with complete data required, all the irrelevant variables were removed from the file and the variables necessary for selection along age, gender, height, weight of the children were kept in file to prepare data eligible for standard growth chart development. The protocol adopted for selection of cases is elaborated in the flow diagram (Fig. 2). This selection enabled us to make our selection comparable to the WHO standards[3] also the selection suggested by the authors of Indian standard[10].

CONCLUSION

This strategy will be a landmark document, as it can help many developing countries to work on their own indigenous standards for children growth by using the data gathered through MICS round 6. Also it is recommended that in future rounds of MICS, the direct information on exclusive breastfeeding and a dummy variable for severe illness must be included in survey form.

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