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# How Is Context Addressed in Growth Monitoring? A Comparison of the Tanzanian, Indian, and Dutch Manuals

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## ABSTRACT

**Background:** To address malnutrition in all its forms, context should be taken into account in growth-monitoring (GM) practices.

**Objectives:** The aim was to compare GM manuals of countries with different nutrition problems, and to assess how these manuals are adapted to the different biological, socioeconomic, and cultural contexts.

**Methods:** GM manuals from Tanzania, India, and the Netherlands were compared with each other, and with the materials for the WHO training course on child growth assessment. First, the aims of GM, growth measurements, interpretation of these measurements, and counseling approaches are compared. Second, contextual determinants of malnutrition are identified using the UNICEF framework for malnutrition as an analytical model.

**Results:** Our results show that the GM manuals differ in their descriptions of the aim of GM, growth measurements, their interpretation, and counseling approaches. Assessing normal growth and detecting growth problems are among the aims of GM in all of the analyzed countries. In Tanzania and India, the focus is mainly on undernutrition, whereas the Dutch manuals focus on overweight and on underlying pathologies that contribute to poor linear growth. The findings of our analysis of contextual factors within the UNICEF framework show that the Tanzanian protocol is only minimally adapted to the local context. Of the manuals examined in our study, the Indian manual is most focused on the contextual determinants of malnutrition, and stresses the importance of taking customs and beliefs into account. The Dutch protocol, by contrast, emphasizes the importance of the biological environment, including parental height and ethnicity, as determinants of child growth.

**Conclusions:** The country manuals we analyzed only partly reflect the contexts in which children live. To address malnutrition in all its forms, the GM manuals should take children's biological, socioeconomic, and cultural contexts into account, as this would help health professionals to tailor counseling messages for parents. *Curr Dev Nutr* 2022;6:nzac023.

**Keywords:** child growth monitoring, nutrition guidelines, context, double burden of malnutrition, counseling, translational nutrition, implementation science

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Abbreviations used: AWW, Anganwadi worker; GM, growth monitoring; GMP, growth monitoring and promotion; MUAC, midupper arm circumference; SDG, Sustainable Development Goal; SDS, SD score.

## Introduction

Growth monitoring (GM) was first introduced in the 1970s, and is now integrated into child-care practices in almost every country around the world. GM has been described as "a process of following the growth of a child compared with a standard by periodic, frequent anthropometric measurements and assessments," with its main purpose being "to assess growth adequacy and identify faltering at early stages before the child reaches the status of undernutrition" (1, 2). Historically, the main aim of GM has been to detect child malnutrition and reduce child mortality

(3). However, not long after its initial implementation, Ashworth et al. (4) emphasized the need for appropriate growth promotion. Specifically, they recommended adding counseling as a component of the GM session, and taking the child's real-life circumstances, and thus the family's context, into account. GM and promotion (GMP) has been described as a prevention activity that is based on effective communication and interactions with the caregiver with the goal of prompting adequate action to promote child growth (1, 2).

The double burden of malnutrition—i.e., the simultaneous occurrence of under- and overnutrition within countries, households, and

**TABLE 1** Background information on the 3 countries included in the comparison of growth monitoring manuals<sup>1</sup>

	Tanzania	India	The Netherlands
<b>Demographics</b>			
Inhabitants, <sup>2</sup> millions	57.3	1339.2	17.1
Population growth, <sup>2</sup> % annually	3.1	1.1	0.6
Urban population, <sup>2</sup> %	33.1	33.6	91.1
<14 y	44.9	27.8	16.4
15–64 y	52.0	66.2	64.8
>65 y	3.1	6.0	18.8
GNI, <sup>2</sup> per capita, US dollars	920	1790	46,910
UN Human Development Index rank <sup>3</sup>	154	130	10
<b>Health</b>			
Life expectancy, <sup>2</sup> y	66.3	68.8	81.6
Fertility rate, <sup>2</sup> births per woman	5.0	2.3	1.7
<5 y mortality, <sup>2</sup> per 1000 live births	54.0	39.4	3.9
Noncommunicable diseases, <sup>2</sup> % of all deaths	32.9	62.7	89.6
Communicable diseases, <sup>2</sup> % of all deaths	55.8	26.0	5.2
DTP immunization, <sup>2</sup> % at 2 y	97	88	94
Underweight, % of female population	9.5 <sup>4</sup>	22.9 <sup>4</sup>	3.2 <sup>5</sup>
Overweight, % of female population	28.4 <sup>4</sup>	20.7 <sup>4</sup>	47.2 <sup>5</sup>
Underweight, <sup>2</sup> % of children	13.7 (0–5 y)	35.7 (0–5 y)	—
Stunting, <sup>2</sup> % of children	34.4 (0–5 y)	38.4 (0–5 y)	—
Wasting, <sup>4</sup> % of children	4.4 (0–5 y)	21.0 (0–5 y)	—
Overweight, % of children	4.3 (0–5 y) <sup>4</sup>	2.1 (0–5 y) <sup>4</sup>	14.9 (girls 2–20 y) <sup>6</sup>

<sup>1</sup>DTP, Diphtheria-Tetanus-Pertussis; GNI, Gross National Income.

<sup>2</sup>Databank World Bank 2017.

<sup>3</sup>United Nations Development Program Human Development Reports 2017.

<sup>4</sup>The Demographic Health Survey program 2015–2016.

<sup>5</sup>Health Monitor 2012, the Netherlands.

<sup>6</sup>Fifth National Growth Study, Netherlands Organisation for Applied Scientific Research, the Netherlands.

even individuals (5–8)—calls for the strengthening of the preventive power of GMP. Understanding the context in which a child lives is crucial when formulating a counseling message for the parents in relation to the child's growth.

Following the release of new universal growth charts in 2006 (9), the WHO developed a training course on child growth assessment for health professionals that focused on measurement, interpretation, and counseling (10–15). The WHO recommended that local health ministries and health councils adapt these manuals to their specific circumstances and need to ensure that counseling messages are better targeted to the diverse circumstances in which children live.

Although GM has improved the nutritional status of children, facilitated the use of health care services, and reduced child mortality, inequalities within and between countries remain large (16), and many countries are still failing to meet the targets for reducing child mortality set in the Sustainable Development Goals (SDGs) (17). Scholars and policymakers have been debating the efficacy of GMP (4, 18), as its potential to reduce inequalities in child mortality and the various forms of child malnutrition has not been fully realized (19).

Bégin et al. (20) emphasized the importance of rethinking GMP by introducing a paradigm shift in which GMP programs are tailored to their geographic and cultural contexts. We suggest that further improvements in the GM manuals could be part of such a shift. Fully understanding how GM manuals have embraced the “P” in GMP, and have been adapted in various contexts, is a first step towards optimizing the training of health professionals, and towards accounting for the local context through the adoption of tailored counseling messages. In our analysis, we compare GM manuals from 3 countries with different

nutrition problems: Tanzania, India, and the Netherlands. We then examine the extent to which these manuals are aligned with the materials of the WHO's training course on child growth assessment. Specifically, we compare the descriptions of the purpose of GM, the growth measurements, the interpretation of growth measurements, and the contextualization of the counseling messages in these manuals and materials. We define context as “the circumstances that form the setting for an event, statement, or idea, and the terms in which it can be fully understood” (21). Our focus is on the biological, socioeconomic, and cultural contexts of the children whose growth is being assessed.

## Methods

### Countries included

This study is part of a larger project on child growth by the International Union of Nutritional Sciences Task Force “Towards a multi-dimensional index for child growth” that includes Tanzania, India, and the Netherlands. These countries have been selected to represent different nutrition problems in various geographic and sociocultural contexts. Sociodemographic and health background data for Tanzania, India, and the Netherlands are presented in [Table 1](#).

### Study design

For our comparison of the manuals, we applied a qualitative content analysis (22). The comparison was made in 2 steps. First, each country's GM manual was assessed based on the materials of the WHO training course on child growth assessment for health care professionals. Second,

**TABLE 2** Growth monitoring manuals and protocols included in the comparative analysis

	Documents
WHO	Training Course on Child Growth Assessment, WHO Child Growth Standards: <ol style="list-style-type: none"> <li>Introduction (10)</li> <li>Measuring a Child's Growth (11)</li> <li>Interpreting Growth Indicators (12)</li> <li>Counseling on Growth and Feeding (13)</li> <li>Girl's Growth Record (14)</li> <li>Job-aid: Investigating Causes of Undernutrition and Overweight (15)</li> </ol>
Tanzania	<ol style="list-style-type: none"> <li>Child Health Handbook, Ministry of Health and Social Welfare (24)</li> <li>Guidelines for Monitoring Growth and Development of the Child, Ministry of Health and Social Welfare (32)</li> </ol>
India	<ol style="list-style-type: none"> <li>Growth monitoring manual, National Institute of Public Cooperation and Child Development (25)</li> <li>A Guide for Use of the Mother-Child Protection Card (26)</li> </ol>
The Netherlands	<ol style="list-style-type: none"> <li>Youth Health Care Guideline Contact Moments Basic tasks package Youth health care 0–19 y (JGZ-Richtlijn Contactmomenten Basistakenpakket 0–19 jaar) (29)</li> <li>Youth Health Care Guideline Overweight Prevention, Signalling, Intervention, and Referral (JGZ-Richtlijn Overgewicht Preventie, signalering, interventie en verwijzing) (33)</li> <li>Youth Health Care Guideline Signaling and Referral Criteria for Short Stature (JGZ-Richtlijn Signalering van en verwijscriteria bij kleine lichaamslengte) (National Institute for Public Health and the Environment, 2010) (34)</li> <li>Growth charts 2010, Manual for weighing and measuring children and plotting of the growth charts. (Groeiogrammen 2010 Handleiding bij het wegen en meten van kinderen en invullen van groeiogrammen) (30)</li> <li>Growth book 0–4 y (Groeigids 0–4 jaar) (31)</li> </ol>

to identify the contextual determinants of GM, the UNICEF framework for malnutrition (23) was used.

### GM manuals, guidelines, and charts

There are a broad variety of manuals, guidelines, and protocols concerning child health, and health professionals use different types of files and cards to keep track of children's health. In our analysis, we considered only the manuals and guidelines and files and cards that public sector health professionals use in the daily practice of child GM.

The materials for the WHO training course on child growth assessment are used as a benchmark for assessing the manuals of each country. The course consists of the introduction, measurement, interpretation, and counseling modules (10–13), as well as modules on child growth records (14) and job aids (15). The latter is a tool for health professionals seeking to investigate the causes of undernutrition and overweight. In Tanzania and India, the manuals and the guidelines for using the growth charts were developed by the respective national ministries of health. The Tanzanian Child Handbook includes information on maternal and child health as well as on GM (24), as GM is embedded in the country's larger newborn and child health program. The guidelines include instructions for health professionals on how to measure and interpret child growth, and on how to counsel parents (32). The Indian GM manual is written for functionaries of the Infant and Child Development Scheme (ICDS) (25), and for use by other health professionals involved in GM. The guide provides instructions on how to fill out the growth record, and on how to counsel the parents (26). In private clinics in India, national growth curves are used (27, 28). As our focus is on national health services, we have not included these charts and manuals in our analysis. In the Netherlands, several organizations and institutes have developed a range of documents that are used in youth health centers. These documents include guidelines on contact moments (29), a manual on weighing and measuring children and plotting growth charts (30), separate guidelines on children with overweight (33) and short stature (34), and a growth book for parents (31). These manuals can

be compared with the Tanzanian and Indian manuals. In the Netherlands, additional guidelines are used in the youth health care system, such as guidelines on food and nutrition, child development, and parenting. However, we have not included these guidelines in our analysis, as they do not refer to child growth.

Local experts in the 3 countries have confirmed that these manuals and protocols are the main ones used for GM. The Tanzanian documents were written in Kiswahili. For the purposes of this research, they were translated into English by a qualified translator. The GM materials we analyzed are presented in **Table 2**.

### Analysis

Our comparison of the manuals with the WHO training materials is deductive, and the analytical themes we identify are reflected in the topics of the manuals—that is, measurements, interpretation, and counseling. The purpose of GM has been added as an additional theme. This first round of analysis is described in the descriptive comparative analysis (section Descriptive comparative findings). In a second round, the manuals were analyzed against the UNICEF framework to assess the extent to which the context is included (section Contextual determinants of child growth). This round includes both deductive and inductive coding (35) (deductive coding refers to codes that resonate with a predefined model of analysis; inductive codes emerge from the data and are added to the conceptual model in order to build theory). Some of the coding is deductive because the analysis is based on the concepts of the UNICEF framework—that is, immediate, underlying, and basic causes of malnutrition. Other parts of the coding are inductive because we allow codes to emerge that are not included in the UNICEF framework. Two codebooks were developed based on the results of that analysis: a descriptive codebook that focuses on information on (the background of) malnutrition and a prescriptive codebook that focuses on cues for the health care provider to take action. The codebooks are added as **Supplemental Materials**.

## Positionality

Unlike in the positivist paradigm that is mainly used in quantitative nutrition research, in the interpretative paradigm (36) the researcher's position is an integral part of the research, and therefore needs to be specified. The first author, SJNvZ, is a general practitioner from the Netherlands. She has been trained and has worked as a tropical doctor in low-income countries. In this latter function, she was responsible for providing medical treatment and managing a therapeutic feeding center in Sierra Leone. Her last occupation was as a general practitioner at a practice that follows an anthroposophic philosophy in the Netherlands. The second author, HHH, has a background in biological and social scientific approaches to child nutrition. She has lived in Tanzania and has been involved in nutrition research in all 3 countries included in this research.

## Quality control and ethics

When questions about the information provided in the manuals have arisen during the analysis, SJNvZ contacted local experts for clarification. These are scientists working in the field of prevention and community care (all 3 countries), as well as health professionals from well-baby clinics (Netherlands) or ministries of health (Tanzania). These local experts have also been asked to check the initial findings. Moreover, the final interpretation of the GM manuals and the use of terminology has been cross-validated by the co-authors and these local experts. A waiver for institutional review was granted by the Research Ethical Committee of the Faculty of Spatial Sciences of the University of Groningen, as the research does not concern personal data.

## Results

First, we present our descriptive comparative findings following the WHO training course materials on: the purpose of growth monitoring, the measurement of growth, the interpretation of growth measurements, and approaches to growth counseling. Second, we provide an analysis of contextual determinants of child growth using the UNICEF framework of malnutrition for malnutrition as an analytical model and as retrieved from the protocols: immediate determinants; underlying determinants; and basic determinants.

## Descriptive comparative findings

### *The purpose of GM.*

In this first section, we describe the purpose of growth monitoring, and whether and, if so, how counseling is included as an aim of GM in each of the 3 countries. The WHO training course materials (10) describe the purpose of GM as the detection of whether a child is growing “normally”, or whether the child has a growth problem, or is likely to have such a problem in the future.

“Basic growth assessment involves measuring a child's weight and length or height and comparing these measurements to growth standards. The purpose is to determine whether a child is growing “normally” or has a growth problem or trend towards a growth problem that should be addressed” [WHO, (10)].

With respect to counseling—i.e., the “P” in GMP—the WHO materials state the following:

“If a child has a growth problem or trend towards a growth problem, the health care provider should talk with the mother or other caregiver to determine the causes. It is then critically important to take action to address the causes of poor growth. Growth assessments that are not supported by appropriate response programs are not effective in improving child health” [WHO, (10)].

*i. Tanzania.* The Tanzanian manual refers to the purpose of GM mentioned in the WHO training materials, in that it describes how children “should” grow (32). Thus, the purpose of the guidelines in the Tanzanian manual is to help health professionals measure and weigh children in an appropriate manner. The visits to the mother-and-child health clinic can have 2 purposes: vaccination or GM.

Although the Tanzanian manual mentions counseling as an additional purpose of GM, it does not give further instructions on how to do so:

“It is important for health care providers to understand how to take measurements and the use of information contained in this book so they can use it in an interview, health education and counseling” [Tanzania, (32)].

*ii. India.* The Indian manual describes the main goal of GM as the detection of underweight in children so that appropriate action can be taken when needed. It also notes the importance of visualizing child growth and providing guidance on child growth to mothers.

“Weight-for-age is used as an indicator for detecting early growth faltering, assessing nutritional status of children and taking appropriate measures on the first signs showing inadequate growth or no weight gain or loss of weight, for preventing and reducing undernutrition” [India, (25)].

“Growth monitoring is a regular measurement of growth which enables mothers to visualize growth, or lack of it, and obtain specific, relevant and practical guidance to ensure continued regular growth and health of children” [India, (25)].

The Indian manual very explicitly emphasizes the importance of the counseling process (chapter 6), and gives very detailed instructions for counseling:

“Now, we are ready to discuss the most important step in growth monitoring: using the growth curve information of each child to give specific advice to mothers to make sure their children keep growing normally. The growth trend of the child should be discussed with the mother every month immediately after weighing” [India, (25)].

*iii. The Netherlands.* The purpose of GM in the Netherlands is the detection of overweight (37), and screening for underlying pathologies when poor linear growth is detected (37, 38).

The guidelines for addressing short stature do not refer to nutritional problems or other underlying factors. Instead, only screening for pathologies is recommended.

“The goal (of the criteria for lagging length growth) is early detection of diseases which affect growth” [Netherlands, (34)].

The goal of the guidelines for addressing overweight is 3-fold (37): prevention, intervention in case of overweight, and referral to screen for underlying pathologies in case of obesity. If a child has overweight, the



**TABLE 3** Growth monitoring measurements as described in the WHO training course materials and by country

	WHO	Tanzania	India	The Netherlands
Weight	Yes	Yes	Yes	Yes
Length	Yes	Yes	No	Yes
Weight/height	Yes	Yes	No	Yes
BMI	Yes	No	No	Yes
Midupper arm circumference	No	Yes	No	No
Head circumference	No	No	No	Yes
Blood pressure	No	No	No	Yes, if >5 y with overweight
Temperature	No	Yes	No	No
Observations	Kwashiorkor Marasmus Edema Wasted  Lean Normal Heavy Overweight Obese	Kwashiorkor Marasmus Edema	Kwashiorkor Marasmus Edema Micronutrient deficiencies	Body figure Fat distribution Ethnicity Puberty  Dysmorphic features Disproportion
Development	Development milestones	Development milestones	Development milestones	Development milestones

parents are invited for additional consultation to the health care center. The guidelines state that they should be applied in a culturally sensitive manner, and take into account the socioeconomic position of the family. However, they do not explicitly mention counseling as a purpose of GM.

#### Measurements.

The GM manuals of the 3 countries differ in terms of the measurements that are included, as can be seen in [Table 3](#) (32, 30, 38). In Tanzania and the Netherlands, the assessment of both weight and height is recommended. In India, only the measurement of weight is advised. In the Tanzanian manual, measurement of the midupper arm circumference (MUAC) is also recommended for assessing underweight if a measuring board is not available and height cannot be measured. The Dutch manual and guidelines for overweight include calculation of BMI (30, 33). In addition to weighing and measuring, the manuals in the 3 countries call for the use of developmental milestones in assessing child growth.

#### Interpretation of the measurements.

**Growth charts.** The WHO presents growth charts by sex for length-for-age, weight-for-age, weight-for-length, and BMI-for-age for the following age intervals: 0–6 mo, 6 mo to 2 y, and 2 to 5 y (12, 14).

*i. Tanzania.* Tanzania uses the WHO charts for weight-for-age, length-for-age, and weight-for-length, but with different age intervals (24). The Tanzanian charts cover the full age range from 0 to 5 y (24). An extra column in the Child Health Handbook is added to provide information on MUAC.

*ii. India.* India only applies the weight-for-age WHO chart, as height is not measured. On the Mother-Child Protection Card (MCPC), the age interval of 0–3 y is used (26). In the GM manual, the interval of 0–5 y is used (25).

*iii. The Netherlands.* The Netherlands has developed its own national charts for length-for-age, weight-for-age, weight-for-length, and BMI-for-age (30). Dutch charts are available for the following age intervals: 0–15 mo, 0–4 y, and 1–21 y old (30). GM mainly occurs between 0 and 5 y, with only 2 GM sessions recommended between 5 and 21 y of age. The charts are updated every 10–15 y and are descriptive in nature. The weight-for-age and weight-for-length charts are based on the population in 1980 (i.e., before the start of the obesity epidemic). These charts are kept unchanged and can be considered normative. International BMI-for-age charts are available from 2 y of age onwards (30), and are based on the International Obesity Task Force reference (including a sample of Dutch children) (30). Separate charts for all age groups have recently become available for children with a South Asian background (39) and for children with Down syndrome (40). For children aged 1–21 y old, separate charts are available for the Turkish and Moroccan populations living in the Netherlands (30). [Table 4](#) presents the various growth charts adopted by country, their reference population (including age), and the frequency of measuring.

[Tables 5–8](#) present the cutoff points used in the WHO training materials and the various country manuals. The WHO charts apply –3, –2, –1, 0, +1, +2, and +3 z-score cutoff points presented as lines (12). [Table 5](#) presents the meanings given to each of the cutoffs.

*i. Tanzania.* The Tanzanian protocol defines an outcome of a +2 and –2 z-score for all indicators as normal growth ([Table 6](#)). The z-score line crossing is mentioned as indicative of a growth problem, but the meaning of the slope of the plotted growth line (whether upwards or downwards) is not explained in the manual (32).

*ii. India.* The cutoffs for weight-for-age in the Indian protocol are adopted from the WHO manual. To make the chart easier to

**TABLE 4** Growth charts, reference population, and frequency of measuring as included in the WHO training course materials and in the country manuals<sup>1</sup>

	WHO	Tanzania	India	The Netherlands
Chart	Weight/age Length/age Weight/length BMI/age	Weight/age Length/age Weight/length	Weight/age	Weight/age Length/age Weight/length BMI/age HC/age
Reference population	International population from WHO-MGRS	International population from WHO-MGRS	International population from WHO-MGRS	Weight/age, weight/length: national population 1980 Length/age: national population 2010 BMI/age: international population from IOTF
Frequency of measuring	Not specified	<2 y: monthly <5 y: quarterly	<1 mo: weekly <3 y: monthly <5 y: quarterly	<6 mo: monthly <1 y: every 2–3 mo <4 y: yearly

<sup>1</sup>HC, head circumference; IOTF, International Obesity Task Force; MGRS, Multicenter Growth Reference Study.

understand, it is presented with colored bands. The green band for normal weight corresponds to a +1 to –2 z-score. The orange band for underweight corresponds to a –2 and –3 z-score. The red band for severely underweight reflects a z-score of below –3. “Just above the green band” is considered normal, whereas “far above the green band” points to a possible growth problem (overweight) (Table 7). The meaning of the slope of the plotted growth line is indicated. A line that follows the growth curve is defined as good; a flat line indicates that attention is needed; and a downward line indicates that there is a problem that requires further investigation or a referral.

*iii. The Netherlands.* The Dutch charts (30, 34, 33) are presented with z-score lines. In these charts,  $\pm 1$ ,  $\pm 2$ , and  $\pm 2.5$  (Table 8) are referred to as SD scores (SDSs). For children with a height-for-age of <1 SDS, the guidelines for short stature apply (34). While the WHO cutoff for overweight is a +2 z-score; the Netherlands applies a more conservative cutoff of a +1 z-score for weight-for-height to detect overweight in children younger than 2 y old (Table 8). For older children, the International Obesity Task Force cutoffs for overweight and obesity are used, and the charts are presented with bands. The guidelines for overweight (33) recommend the use of clinical judgment in identifying overweight (33).

### Counseling.

The WHO counseling module (13) contains questions for group discussions and examples of how to counsel the parents. It includes information for health professionals on the underlying causes of under- and overnutrition, as well as advice on how to counsel the parents. The counseling module presents an adapted version of the UNICEF framework for malnutrition. In addition, the WHO job aids (15) are designed as tools to help health professionals identify the causes of child malnutrition, and to counsel mothers accordingly. It includes specific questions that can be used to further investigate the underlying causes of malnutrition, as well as to give relevant advice. The focus of these questions is on feeding and hygiene, with some additional questions on the socioeconomic causes of malnutrition. For example, the parents may be asked: Has the child been breastfed less than usual? Has the child experienced trauma?

*i. Tanzania.* The Tanzanian manual includes the WHO job aids (for both under- and overnutrition) designed to help health professionals formulate counseling messages and possible solutions. However, the manual provides no information on the underlying causes of malnutrition in Tanzania, and the adaptation of the WHO job aids to the

**TABLE 5** WHO cutoff points for child growth indicators presented in charts<sup>1</sup>

	Growth indicator			
	Length-/height-for-age	Weight-for-age	Weight-for-length/height	BMI-for-age
z-Score > +3	Very tall	May have growth problem	Obese	Obese
z-Score > +2	Normal	May have growth problem	Overweight	Overweight
z-Score > +1	Normal	May have growth problem	Possible risk of overweight	Possible risk of overweight
0 (median)	Normal	Normal	Normal	Normal
z-Score < –1	Normal	Normal	Normal	Normal
z-Score < –2	Stunted	Underweight	Wasted	Wasted
z-Score < –3	Severely stunted	Severely underweight	Severely wasted	Severely wasted

<sup>1</sup>Data from reference (12).

**TABLE 6** Tanzania cutoff points for child growth indicators presented in charts<sup>1</sup>

	Growth Indicator		
	Length-/height-for-age	Weight-for-age	Weight-for-length-/height
z-Score > +3	Not mentioned	Not mentioned	Obese
z-Score > +2	Not mentioned	Not mentioned	Overweight
z-Score > +1	Normal	Normal	Normal
0 (median)	Normal	Normal	Normal
z-Score < -1	Normal	Normal	Normal
z-Score < -2	Stunted	Underweight	Wasted
z-Score < -3	Severely stunted	Severely underweight	Severely wasted

<sup>1</sup>Data from reference (28).

local situation appears to be minimal (see the section on context below) (24).

*ii. India.* By contrast, the Indian manual guides health professionals in how to investigate underweight in a participatory fashion, and in how to translate the results into a tailor-made message to parents (25). The manual provides examples of questions and pictures. Health professionals are instructed to ask and listen to the mother's story about what has happened to the child in terms of eating, illness, or other problems (25):

“The SECOND step is to ask the mother what has been happening to the child during the last month to make her child's growth pattern happen that way. Too often, we start telling the mother what to do without listening to her and finding out the reasons why the child is not growing. We must remember that the mother knows the most about her child, and she is the person who can make the changes to improve the child's growth. LISTEN carefully to what the mother has to tell you about what the child has been eating and how much, if the child has been sick, if there has been any other problem” [India, (25)].

*iii. The Netherlands.* In the Netherlands, the guidelines for overweight and short stature are very extensive in terms of providing background information, but do not include directions on how to communicate the findings to the parents. The only reference in the overweight guidelines to the importance of communication training for health workers is found in the annex. Several communication techniques that can be used for counseling the parents on a child's overweight are described (such as motivational interviewing). The guidelines also include anamnesis checklists for the age categories 0 to 2 y and 2 to 19 y.

**TABLE 7** India cutoff points for child growth indicator in chart<sup>1</sup>

	Growth indicator: weight-for-age
z-Score > +3	Growth problem
z-Score > +2	Growth problem
z-Score > +1	Growth problem
0 (median)	Normal
z-Score < -1	Normal
z-Score < -2	Moderately underweight
z-Score < -3	Severely underweight

<sup>1</sup>Data from reference (25).

### Contextual determinants of child growth

To further investigate the extent to which the manuals of each of the 3 countries addresses the context, and to explore how devoting attention to this fundamental issue could inform the counseling sessions and facilitate locally embedded messages to parents, we have analyzed the manuals, focusing on their discussion of the contextual determinants. For this assessment, we used the UNICEF framework for malnutrition (23) as an analytical model—that is, we categorized the contextual determinants into immediate causes, underlying causes, and basic causes. An overview of the main findings is presented in Table 9. In the section below, we present quotes from the various manuals to illustrate our findings.

#### Immediate causes of malnutrition.

Two deductive themes were identified from the analysis of the manuals compared with the UNICEF framework for malnutrition: dietary intake and illness. In addition, physical activity emerged as an inductive theme.

*i. Dietary intake.* The WHO counseling module (13) and the WHO job aids (15) focus on feeding as an immediate cause of growth problems. Reference is made to both undernutrition and overweight. The WHO Child Growth Record (14) gives recommendations on the frequency of feeding and portion sizes.

“Particularly in late infancy (age 6–12 months), a child may be overfed by parents who are anxious to keep up the child's weight” [WHO, (13)].

Similarly, in the country guidelines, dietary intake is the most extensively addressed cause of growth problems. The Tanzanian Child Health Handbook copies the standard WHO food and feeding recommendations, using the same pictures and bullet points (24). However, some contextualization can be observed from the use of local terminology, such as how certain foods can contribute to the “maintenance of heat.”

In the Indian GM manual (26) and in the Dutch guidelines (29, 31) dietary advice is adjusted to the local diet. The Indian advice is practical and refers to certain food products.

*ii. Illness.* In the WHO counseling module (13) and the WHO job aid (15), any acute or chronic illnesses a child has are mentioned as immediate causes of growth faltering. In the Tanzanian (32) and Indian (25) manuals, maternal chronic diseases are added as a risk factor:

“If the child is currently ill or has a chronic disease that could be a cause of undernutrition...” [WHO, (13)].



**TABLE 8** The Netherlands cutoff points for overweight charts<sup>1</sup>

	Growth indicator	
	Weight-for-length/ -height (0–2 y)	BMI-for-age (> 2 y)
z-Score > +3	Not mentioned	Using IOTF growth criteria as indicated in growth chart
z-Score > +2	Obese	Using IOTF growth criteria as indicated in growth chart
z-Score > +1	Overweight	Using IOTF growth criteria as indicated in growth chart
0 (median)	Not mentioned	Using IOTF growth criteria as indicated in growth chart
z-Score < -1	Not mentioned	Using IOTF growth criteria as indicated in growth chart
z-Score < -2	Not mentioned	Using IOTF growth criteria as indicated in growth chart
z-Score < -3	Not mentioned	Using IOTF growth criteria as indicated in growth chart

<sup>1</sup>Data from reference (33). IOTF, International Obesity Task Force.

“A mother’s health is closely linked to a child’s health. If the mother did not attend any clinic...or being tested for syphilis and HIV, then make sure she first gets these services...” [Tanzania, (32)].

“She [the Anganwadi worker (AWW)] should then try to find out the possible causes of underweight...Repeated infections, such as diarrhea, measles or worm infestations etc...child suffering from a chronic disease like tuberculosis, inability to digest milk etc.” [India, (25)].

The Dutch guidelines for short stature (34) call for the early identification of hereditary causes or chronic diseases in relation to linear growth faltering, even though it has been recognized that growth faltering as a symptom will become apparent after other symptoms have appeared.

Physical activity is mentioned as an immediate cause of growth problems in the WHO job aid (15), the Tanzanian manual (32), and in the Dutch guidelines for overweight (33). The latter refer to physical activity counseling messages in relation to overweight prevention.

“Children sometimes gain too much weight because their physical activity level is too low. It is good for a young child to get used to walking from childhood. Don’t put him in the stroller, but go walking together for groceries” [Netherlands, (31)].

The Dutch guidelines for overweight (33) provide a lifestyle intervention for addressing overweight. Through this so-called bridging plan (in Dutch: *overbruggingsplan*), both the parents and the child are sensitized to the problem, and are encouraged to adapt their behavior to help the child lose weight:

“For children >2 years with overweight, lifestyle programs, with combined treatment focusing on three or more different components of lifestyle (nutrition, physical activity and behavior) might be effective according to the protocol. Intervention is advised with an integrated approach to change lifestyle, the ‘Bridging Plan’, through which the so-called BOFT-behaviors are stimulated (stimulating breastfeeding, physical activity and having breakfast and to reduce (sweetened) sodas, fast food, watching television/gaming and (energy rich) snacks)” [Netherlands, (33)].

### Underlying causes.

Five deductive themes and 1 inductive theme emerged regarding the underlying causes of malnutrition: inadequate access to food; inadequate care for women and children; insufficient health services; unhealthy (physical and social) environment; (unfavorable) biological environment (inductive); and inadequate education.

*i. Inadequate access to food.* The WHO counseling manual instructs health professionals about the concept of underlying factors of malnutrition by including an adapted version of the UNICEF framework (13). The WHO’s job aid on undernutrition (15), which is copied in the Tanzanian guidelines (33), investigates food availability as an underlying cause of undernutrition:

“Is there usually enough food to feed the family? If not, what is the main cause of this problem?” [WHO, (15)].

The Indian manual refers to a “lack of required foods in terms of quality and quantity” (25), and to several basic causes underlying this problem, such as a family’s size, income, and available time.

The Dutch guidelines for overweight prevention (33) refer to a reduction in the intake of high-calorie food and in risky food practices:

“Universal prevention (of overweight) includes promotion of Breastfeeding, Exercise, Taking breakfast, and reduction of the intake of Soft drinks, Fast food, (energy-rich) Snacks and watching Television/Gaming (Dutch acronym: BOFT)” [Netherlands, (33)].

*ii. Inadequate care for women and children.* The WHO job aids (15) provide questions on care for women and children that can be included in the GM session to investigate the causes of malnutrition. The child’s growth record (14) discusses the child’s care at different ages in more detail.

The Tanzanian guidelines mention the role of the father in relation to care:

“Does the child’s father spend time with her and assist in the care of the child?” [Tanzania, (38)].

The Indian GM manual mentions maternal care (importance of the mother’s diet or work schedule during lactation). It emphasizes the role not only of the mother, but of the whole family:

**TABLE 9** Contextualizing the causes of malnutrition in growth monitoring manuals using the UNICEF framework for malnutrition as an analytical model<sup>1</sup>

	Tanzania	India	The Netherlands
<b>Immediate causes</b>			
Dietary intake	General advice on foods maintaining body heat and building the body	Advice adjusted to local diet	Advice adjusted to local diet  Reduction in high-calorie foods Risky food practices
Illness	Both child and maternal illness	Both child and maternal illness	Hereditary causes and chronic diseases in case of short stature
Physical activity	Encourage physical activity	Not included	Encourage physical activity Lifestyle intervention for children >2 y
<b>Underlying causes</b>			
Inadequate access to food	Food availability	Food quantity and quality  Influence of family size Income Time available	Intake of high-calorie foods
Inadequate care for women and children	Role of the father	Role of the family  Importance of maternal care Influence diet Work schedule	Family support for caregiver  Practical information on crying  Sleep duration Positive upbringing
Insufficient health services	Focus on physical environment for GM sessions Availability of measurement tools	Importance of response programs  Role of GM functionaries  Organizational challenges (e.g., geographical location, lack of time)	Improved collaboration and clear agreements between care providers for referral
Unhealthy environment	Sanitation issues Protection against physical and emotional abuse or severe anger	Hygienic practices	Obesogenic environment Physical, social, economic, and political environment at micro- and macro-level
Biological environment	Not included	Not included	Smoking during pregnancy Parental overweight High or low birth weight Rapid growth in the first year Gestational diabetes Genetic predisposition Ethnicity
Inadequate education	Feeding skills	Lack of understanding of child nutritional requirements	As an indicator of socioeconomic position
<b>Basic causes</b>			
Human, economic, and organizational resources and control	Family size  Number of children under age 5 in the family Who is the caregiver? Options to ask for assistance	Rich description of basic causes  Family size  Income Lack of time  Family support  Importance of culture	Checklist of basic factors  Low socioeconomic status  Culturally sensitive counseling  Messages in relation to pedagogical support Guidance on relevance of the various factors is lacking Parental leave regulations

<sup>1</sup>GM, growth monitoring.

“Explain to the mother and the family that feeding, playing and communicating with children helps them to grow and develop well” [India, (25)].

The Dutch growth book provides a detailed discussion on different child care issues, including information about crying, sleep duration, positive upbringing, positions in bed, teeth brushing, and continence training (31). The importance of the caregiver receiving support is also discussed in the growth book:

“Do you get enough support from people in your environment? If not, you might want to think about who else to involve. You could also talk to someone from youth health care” [Netherlands, (31)].

Finally, the Dutch GM manual also mentions emotional deprivation and neglect as potential causes of a failure to thrive (34).

*iii. Insufficient health services.* The Tanzanian manual I (38) underscores the importance of health professionals having an appropriate physical environment and access to measurement equipment when conducting GM sessions:

“Community leaders should be involved in order to create a suitable environment including the availability of suitable tables” [Tanzania, (32)].

“Measuring the arm circumference (MUAC) when examining underweight where measuring board is not available” [Tanzania, (32)].

A lack of collaboration in the care chain is mentioned as a potential underlying cause of malnutrition in the WHO’s introduction module (10):

“Growth assessments that are not supported by appropriate response programs are not effective in improving child health” [WHO, (10)].

The protocols of each country further elaborate on the importance of such a care chain. For example, the Tanzanian GM manual (32) describes collaboration in the care chain, and the importance of referring the child to a health clinic if she or he has an acute illness, or the mother to a prevention-of-mother-to-child-transmission (PMTCT) service if she is suspected of having an HIV infection. However, no response programs are described for children who are suffering from malnutrition or overweight.

The Indian GM manual (25) refers to the importance of offering response programs for undernourished children, such as supplementary nutrition programs:

“A food supplement of 500 Kcalories of energy and 12–15 gm of protein per child per day should be provided in the Supplementary Nutrition Programme (SNP)... Severely underweight children need to be provided a food supplement of 800 Kcalories of energy and 20–25 gm of protein” [India, (25)].

In addition, the Indian GM manual underscores the importance of convincing health care professionals of the usefulness of GM for promoting children’s growth and health, as well as organizational challenges related to geographical location and lack of time (that require mothers to assist in the GM session):

“If Integrated Child Development Services (ICDS) functionaries are convinced of the use of growth monitoring to ensure health of children, they can in turn, convince the mothers” [India, (25)].

“She should take help of the mothers in the weighing process” [India, (25)].

The Dutch guidelines for overweight (33) emphasize the importance of a stronger care chain, and suggest that such a chain could be created through improved collaboration and clear agreements between care providers:

“Currently, only 30% of the referrals by youth health care organizations are receiving feedback about referred children, while half of the youth health care organizations do not have regional agreements with chain partners” (Netherlands, (33)).

*iv. Unhealthy environment.* In their general advice, the manuals of all 3 countries, like the WHO, recommend that children have a safe and stimulating physical and social environment. Each protocol focuses on the country’s most relevant challenges, such as poor sanitation, child abuse, or traffic. The WHO refers to the child’s parents having busy schedules as an underlying environmental cause of overweight and obesity:

“For example, a busy family may rely on high-energy convenience foods instead of taking time for leisurely, well-planned meals. Children may not be able to play outdoors safely and thus spend too much inactive time watching television or playing video games. Resolving problems of overweight and obesity will require addressing root environmental causes as well as immediate dietary causes” [WHO, (13)].

The Tanzanian Child Handbook primarily focuses on issues of sanitation, as well as on the importance of protecting children from physical and emotional abuse or extreme displays of anger:

“Protecting children from physical and emotional abuses (e.g., because of violent acts or anger) helps children to become inquisitive, self-confident and eager to learn” [Tanzania, (24)].

The Indian guide for the use of the mother and child protection card also mentions hygiene as an important environmental factor:

“Hygienic practices by mothers/caregivers: Caregivers should wash their hands with water and soap before feeding the child” [India, (26)].

The Dutch guidelines for overweight refer to the obesogenic environment:

“Environmental factors are crucial determinants of food practices and patterns of physical activity. The obesogenic environment refers to an environment that facilitates consuming high levels of energy while at the same time having low energy expenditure due to physical inactivity” [Netherlands, (33)].

“Environmental factors can be divided into the physical environment (having a playground available that is maintained well), the social environment (what do people think when I prefer an apple over a high-caloric snack), the economic environment (how much discount will I get if I buy large quantities), and the political environment. These environmental factors can further be divided into micro- and macro-level environmental factors. Micro-level factors refer to behavior, for example parental authority. Macro-level factors include for example regulations about food supply at school (41, 42)” [Netherlands, (33)].

In the Dutch protocol, smoking during pregnancy is mentioned as a risk factor for overweight in the child (33).

v. (*Unfavorable*) *biological environment (not in UNICEF framework)*. This section refers to the biological environment of the child, which includes both the parents' biological environment and the child's biological environment in early childhood. Parental overweight is mentioned as a risk factor for overweight by the WHO (9) and in the Dutch guidelines for overweight (33). Other biological or genetic risk factors for overweight mentioned in the Dutch guidelines for overweight are high or low birth weight,  $>0.67$ -SD weight increase in the first year, early puberty, depression, gestational diabetes, and genetic predisposition (33).

When interpreting measurements of a child's linear growth, the parents' heights, the child's birth weight, and whether the child was small for his or her gestational age and was born a twin should also be considered. The following quote from the Dutch GM manual illustrates this point:

"Length of twins is 1.24 SD shorter during the first half year... In assessment of the growth chart this should be taken into account" [Netherlands, (34)].

We include ethnicity as a biological, genetic underlying cause of child growth, although it also has a cultural component, and may be seen as a basic cause. Ethnicity as a risk factor for overweight is only mentioned in the Dutch guidelines for overweight. Moreover, these guidelines stipulate that it is unclear whether ethnicity is an independent risk factor, or whether it is mediated by the socioeconomic status, dietary practices, and pedagogical styles of ethnic minorities (33). The assumption in the Dutch manual that ethnicity is a determinant of child growth is reflected in its use of different weight-for-length and length-for-age charts for children of Moroccan and Turkish descent living in the Netherlands (30) and, recently, for children of South Asian descent as well (39). Moreover, for children with Down syndrome, a separate chart is used (40). According to the Dutch guidelines, ethnicity should also be considered when applying a "clinical judgment" in the assessment of overweight (33):

"Different physique than the Dutch may bias BMI, despite the fact that the international criteria for overweight in children are based on measurements of children of different ethnic groups (Cole et al. 2000). Differences have been found between Chinese, Singaporean, Dutch, Mediterranean, and American children (Hall and Cole, 2006)" [Netherlands, (33)].

vi. *Inadequate education*. The protocols refer to education either implicitly or explicitly. The WHO makes an implicit reference to the role of education and mentions poor feeding practices as an underlying cause of malnutrition (15). The Tanzanian manual refers to feeding skills as an underlying cause (32), while the Indian manual refers more explicitly to a lack of understanding of a child's nutritional requirements and the need to educate parents (25). The Dutch GM manual (30) refers to education only in relation to socioeconomic status.

"Many different reasons can cause poor growth... iii. Inability to introduce complementary feeding due to lack of understanding of the child's nutritional requirements" [India, (25)].

#### **Basic causes.**

The WHO and the country manuals mention several basic causes of malnutrition that can all be categorized as causes related to human,

economic, and organizational resources and control, as described in the UNICEF framework for malnutrition.

i. *Human, economic, and organizational resources and control*. The WHO job aids (15) and the Tanzanian manual (32) mention family size, the number of children under age 5 in the household, the identity of the child's caregiver, and the options for asking for assistance as basic causes of malnutrition.

India's GM manual (25) provides rich descriptions of basic causes, including socioeconomic factors such as family size and income, and lack of time.

"Mother does not have enough time to provide care for development" [India, (25)].

- Combine care for development with other care for the child and household chores (feeding, bathing, dressing or cleaning the house) [India, (25)].
- Ask other family members to help provide care for development or help her with other tasks" [India, (26)].

In addition, the importance of culture is emphasized, and some practical tips are given for the health professional to investigate these factors.

"Supervisor should find out from the AWW the problems of her area and attitude and perceptions of mothers about getting their children weighed. She should then work towards correcting the wrong and reinforcing the right ones" [India, (25)].

"During home visit, you can also discuss the child's growth with other family members who are the decision makers" [India, (25)].

The Dutch guidelines for overweight describe many basic risk factors for overweight and offer suggestions for protective measures. They recommend that overweight prevention efforts focus on low-socioeconomic-status groups and be culturally sensitive—that is, that different population groups receive different messages about how to improve their diet and physical activity. The guidelines also recommend that if a child is found to be overweight, the parents' awareness of the problem and their perceptions of the child's weight should be addressed, and the need for pedagogical support should be considered. For example, the questions for parents of children aged  $<2$  y and 2–19 y old include the following:

"What do you think of the weight of your child/are you [the child] satisfied with your weight?" [Netherlands, (33)].

Moreover, the guidelines advise health professionals to discuss the consequences of being overweight with the parents. A checklist of potential contributory factors is provided to the health care workers; however, guidance on which factors are most relevant is lacking.

Political influences are also described, such as the involvement of different government departments in the Netherlands in child care programs and parental leave regulations.

"Until the child is eight years old, both parents have the right to take a period of parental leave. More information about this you can read on [www.rijksoverheid.nl](http://www.rijksoverheid.nl) at the Ministry of Social Affairs and Employment" [Netherlands, (31)].



## Discussion

In this study, we compared GM manuals from Tanzania, India, and the Netherlands, and then compared these manuals with the materials for the WHO's training course on child growth assessment. Our aim was to identify the extent to which the manuals are contextualized. The analysis was conducted in 2 steps. First, we conducted a descriptive analysis following the WHO training materials of the purpose of GM, growth measurements, interpretation of the growth charts, and advice on counseling approaches in these manuals. Second, we used the UNICEF framework for malnutrition (23) to analyze the content of the manuals for reference to contextual determinants of child growth.

Our comparative analysis uncovered important differences in the purpose of GM, the growth measurements, the interpretation of these measurements, and the growth counseling approaches cited in the manuals of the 3 countries. According to the manuals of Tanzania and India, the purpose of GM includes counseling parents about child growth, thus referring to the "P" in GMP. In the Netherlands, the link between GM and promotion is made in the guidelines for overweight, which include recommendations for providing culturally sensitive promotion messages. The differences in the growth measurements and the interpretations of these measurements cited in the manuals largely reflect the prevailing nutritional problems in relation to each country's stage in the nutrition transition (43). To anticipate the increasing burden of overweight in a country such as Tanzania, and to adequately respond to the dramatic rise in diabetes that is likely to result (e.g., in India), we believe the protocols should be much more outspoken about how GM could contribute to efforts to combat the double burden of malnutrition. Emphasizing the "P" in GMP and using adequate indicators to achieve this goal would be a first step. Especially in the case of overweight, determining an appropriate indicator that can be used in community practice is imperative. In Tanzania, overweight is assessed based on weight-for-height, and if height cannot be assessed, MUAC is measured. In the Netherlands, BMI is used as an indicator of overweight from the age of 2 y onwards. In India, overweight is assessed based on the weight-for-age charts. The usefulness of BMI as an indicator of overweight or obesity has been debated, and its validity been shown to be poor even at the higher percentiles (>95%) (44). Moreover, BMI does not reflect the distribution of fat and fat-free mass (45) (i.e., it does not provide information on the real risk of developing metabolic syndrome). Skin-fold or circumference measures give more information about fatness. Finally, the differences in the markers the 3 countries use could lead to productive communications between them, as well as within the individual nations.

Another difference we observed between the manuals in the 3 countries concerns the age intervals used in the charts. Growth charts are not always intuitively understood (46–48), and parents as well as health workers are likely to benefit from adequate visualization and counseling on how to interpret the curves (49). The larger age ranges (0–5 y) used in Tanzania make it more difficult to interpret the growth measurements of the most vulnerable groups.

Second, the WHO growth standards are used in Tanzania and in India, but not in the Netherlands. Dutch public health officials use their own national growth curves, as they argue that the WHO curves perform less well in identifying children with serious underlying growth disorders in the Netherlands (50). The data are collected every 10–15 y,

and the charts are updated accordingly. The charts for overweight are based on the population of 1980—that is, before the start of the obesity epidemic—and can be considered normative for the Dutch population. In addition to charts for the Dutch population, the Netherlands has developed charts for children of Moroccan and Turkish origin (30). As these children tend to be shorter than the Dutch average even below age 5, using the Dutch charts would result in a large percentage of children in these population groups being diagnosed with short stature (51). Care must be taken to ensure that such diagnoses do not cause parents to worry needlessly about their child's height. More recently, separate growth charts have been developed for children from Indo-Surinamese descent. This is based on the argument that these children are born with a lower birth weight and have a higher risk of developing diabetes later in life at a lower BMI compared with the general Dutch population ref, de Wilde (68). Special charts have also been developed for children with Down syndrome (40). For BMI, international charts (including Dutch data) are used (52).

Finally, countries use different cutoffs for the identification of under- or overnutrition, and in their growth charts. The WHO, India, and the Netherlands use conservative cutoffs of a  $\pm 1$  z-score. The Netherlands does so for overnutrition only. However, after completion of the analysis for this paper, new guidelines for underweight with defining criteria have been added to health care practices in the Netherlands (53). For height-for-age, the focus in the Netherlands is on short stature due to underlying pathologies and on overweight. Tanzania uses a cutoff of a  $\pm 2$  z-score for all indicators of malnutrition. In Tanzania and India (weight-for-age only), the main focus is on the detection of undernutrition.

The guidelines for short stature in the Netherlands merit some additional attention. The Netherlands has separate guidelines for identifying short stature as an underlying symptom of serious disorders and diseases that include an extensive flow chart of criteria for referral for further analysis and potential treatment (37). The assumption that short stature is a symptom of underlying pathologies, rather than a sign of undernutrition, could be interpreted as an illustration of the extent to which Dutch GM practices have been medicalized (54). While treatment might be beneficial for some children, it is important to be aware of possible negative psychological side effects. Moreover, the guidelines themselves indicate that, in most cases of underlying pathologies, symptoms other than lagging linear growth will already be present. It is important to note that since the analysis of the results of this study, new guidelines for linear growth have been developed (55). These new guidelines provide more extensive descriptions of normal growth and individual differences, as well as a referral flow chart for both short and tall stature. The guidelines also indicate the (sometimes low) sensitivity of GM to diagnoses of certain diseases or disorders. The new guidelines for underweight provide more guidance to health professionals on how to discuss its causes with the parents (53).

The 3 countries differ in the extent to which they have included and contextualized the information provided in the counseling manual (13) and the WHO job aids (15). In the Indian manual, clear questions are formulated that are complemented with illustrations to further enquire about the child's situation. This approach provides rich information on the child's context. Guidance on how to use this information to craft individually tailored counseling messages is also given in the Indian manual/guidelines (25). The Tanzanian manual provides very little guidance



on how to counsel the parents, and information on malnutrition for health professionals is lacking. In contrast, the Dutch guidelines provide ample information on overweight and short stature (33). However, suggestions for how to communicate this information with parents are lacking. It is important to note that, in addition to the GM manuals that are included in our analysis, the Netherlands has additional guidelines in the youth health care system, including on food and nutrition, child development, and parenting. Moreover, in the Dutch health care system, a nurse visits the parents in their home shortly after the birth of the infant and observes and discusses the family's situation. However, in the manuals on GM, the link between the family context and child growth is not made.

The Indian manuals (25, 26) could be used as an example to inspire other countries to contextualize their counseling manuals and instruct health professionals about how to tailor the counseling messages to the circumstances in which children live.

The richness of the Indian manual also emerged in our contextual analysis using the UNICEF framework. Whereas the WHO and the Tanzanian manual concentrate on the immediate determinants of malnutrition, the Indian manual includes rich information on the underlying and the basic causes of undernutrition and gives direction on how to counsel the parents. The Indian manual pays explicit attention to socioeconomic factors, such as the family's size, income, and lack of time. In addition, the role of culture is emphasized. Hossain et al. (56) and Lucas et al. (57) have stressed the importance of adapting counseling messages to local customs and beliefs to optimize the uptake of such messages by the community. Getting a community perspective on GM, as has been done for a Malingali village in Tanzania (58), can help health professionals better understand families' cultural beliefs, and may contribute to the development of health messages that are embedded in these realities. A recent review by Amanda Thompson (59) on different frameworks for healthy growth across contexts has also stressed the importance of taking parental perceptions of growth into account.

Including the community in GM activities can have an empowering effect, as has been shown in a study of women in Calcutta, India. Moreover, involving the community can broaden the scope of potential solutions for better child growth, such as providing or facilitating a safe water supply, child care activities, home gardens, poultry raising, or income generation (60)—in other words, it can foster the “S” in Social and Behavioral Change Communication (61).

Although it is not part of the UNICEF framework, we identified the biological environment as an underlying cause of malnutrition. Maternal height and parental BMI are mentioned in the WHO training materials and in the Tanzanian and Indian manuals. The Dutch materials provide particularly rich data on the biological determinants of child malnutrition, including parental body composition, rapid growth in the first year, gestational diabetes, and genetic predisposition. Such information could be particularly relevant in countries undergoing the nutrition transition. The importance of growth and development for later health outcomes has been widely recognized through the theory of the developmental origins of health and disease (62, 63) and life history theory (63–65). Rapid growth in the number of infants with low birth weight is a risk factor for the later development of metabolic syndrome (66), which has been called the “catch-up dilemma” (67). Druet et al. (66) suggested combining birth weight and infant weight (or simply infant weight) with the mother's BMI and the child's sex to allow

for an early stratification of infants at risk of childhood obesity. This information could be used to develop relevant counseling messages for the parents of these children. Such an approach would be particularly relevant in the context of countries with a high prevalence of low birth weight, like India, and similarly for children of South Asian origin in other countries, such as the Netherlands (68).

We believe that special attention should be paid to the role of ethnicity as an indicator of the biological environment. The Dutch take a special position in this debate (see above). Since the introduction of the WHO growth charts in 2006, there has been discussion on the extent to which child growth patterns are universal. The WHO Multicenter Growth Reference Study Committee argued and confirmed based on the findings of an analysis of the relevant data that growth curves until the age of 2 are very similar across the world, and may thus be considered universal (69, 70). However, ministries of health in several countries have reported that levels of malnutrition in their populations would be overestimated if the new curves were to be applied and continued using their national charts. The debate about universality mostly concerns height. In the field of body composition, the role of ethnicity in understanding differences between populations has been widely acknowledged (71). In 2009, India developed new national growth charts (27, 28) with the argument that the WHO charts were leading to overdiagnoses of stunting and overweight (28).

The comparisons made in our study were restricted to 3 countries: Tanzania, India, and the Netherlands. Findings from the analysis of the GM manuals from these countries may not apply to other countries. However, we hope that our reflections on the differences between the 3 countries in terms of their growth measurements, interpretations of these measurements, growth counseling approaches, and inclusion of context will be relevant for other countries, and can help them adapt the current GM materials to address the double burden of malnutrition (72). In our analysis, we did not take a gender perspective. The focus in the manuals is mostly on the mother as the child's caregiver and food provider. India makes reference of the importance of the whole family and of the role of the father, and the WHO materials as well as the Indian manual mention the busy schedule of mothers in relation to their caring capabilities. Future modifications of the GM materials should also take gender roles into account, acknowledging, for example, that taking care of children is only one of the roles that mothers have in addition to their other workloads and that fathers are also caregivers.

Our research is an example of translational nutrition science (73). Although the WHO growth curves are designed for universal application, the internal validity of their application must be contextualized based on the circumstances in which they are used. We have shown how a descriptive, comparative analysis of current guidelines in health and nutrition can inform the further development and contextualization of such guidelines and can have implications for public health; in this case, for child GM. Our results indicate that context matters for child growth, and that the current GM manuals may need to be improved to reflect the local context. Addressing this challenge is urgent given the current complexity of nutrition problems, including the double burden of malnutrition.

A limitation of our research is that it did not involve the engagement of relevant stakeholders in the design, analysis, and interpretation of the results. The findings reflect the interpretation of the authors and may not necessarily reflect those of the institutions responsible for the GM

manuals in the 3 countries. We suggest that this paper could be the start of such a dialogue with stakeholders. Furthermore, it is important to note that our findings merely reflect how context is addressed in the GM manuals. This could be different from how it is addressed by the health professional in the practice of a GM session.

Finally, the primary focus of all of the country manuals is on feeding as an immediate determinant of malnutrition, reflecting the biomedical paradigm in which the nutrition sciences are situated. This focus appears to be effective, as the success of many nutrition interventions shows. However, in many countries, efforts to further reduce child malnutrition seem to be stagnating, and the chances that these countries will meet the SDGs are low. As many observers have argued, expanding a multidimensional focus with an emphasis on context is likely to be productive (60–63). WHO/UNICEF/International Atomic Energy Agency (IAEA) have joined forces to combat the double burden of malnutrition (74) and, in line with Bégin et al. (20), to begin rethinking GM. In support of these efforts, we close by stressing the importance of including the contexts in which children live in future efforts directed at tackling the double burden of malnutrition (19).

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### Authors contributions

The authors' responsibilities were as follows—SJNvZ: conducted analysis; SJNvZ and HHH: wrote the manuscript, designed the research, interpreted the findings, share responsibility for the contents of the manuscript, and read and approved the final manuscript.

### Data Availability

The codebook is uploaded as supplemental materials; any further information required is available through the first author.

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