

Implementation of the WHO Multicentre Growth Reference Study in Brazil

Cora L. Araújo, Elaine Albernaz, Elaine Tomasi, and Cesar G. Victora, for the WHO Multicentre Growth Reference Study Group

Abstract

The World Health Organization (WHO) Multicentre Growth Reference Study (MGRS) South American site was Pelotas, Brazil. The sample for the longitudinal component was drawn from three hospitals that account for approximately 90% of the city's deliveries. The cross-sectional sample was drawn from a community survey based on households that participated in the longitudinal sample. One of the criteria for site selection was the availability of a large, community based sample of children whose growth was unconstrained by socioeconomic conditions. Local work done in 1993 demonstrated that children of families with incomes at least six times the minimum wage had a stunting rate of 2.5%. Special public relations and implementation activities were designed to promote the acceptance of the study by the community and its successful completion. Among the major challenges of the site were serving as the MGRS pilot site, low baseline breastfeeding initiation and maintenance rates, and reluctance among pediatricians to acknowledge the relevance of current infant feeding recommendations to higher socioeconomic groups.

Cora L. Araújo is affiliated with the Departamento de Nutrição, Universidade Federal de Pelotas, Brazil. Elaine Albernaz is affiliated with the Núcleo de Pediatria, Universidade Católica de Pelotas, Brazil. Elaine Tomasi is affiliated with the Escola de Psicologia, Universidade Católica de Pelotas, Brazil. Cesar G. Victora is affiliated with the Departamento de Medicina Social, Universidade Federal de Pelotas, Brazil.

Please direct queries to: Mercedes de Onis, Study Coordinator, Department of Nutrition, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland. Telephone: 41-22-791 3320; fax: 41-22-791 4156; e-mail: deonism@who.int.

Members of the WHO Multicentre Growth Reference Study Group and Acknowledgments are listed at the end of the first paper in this supplement (pp. S13–S14).

Mention of the names of firms and commercial products does not imply endorsement by the United Nations University.

Key words: Anthropometry, Brazil, breastfeeding, child health, child nutrition, growth, growth monitoring, growth references, infant feeding practices

Introduction

The World Health Organization (WHO) Multicentre Growth Reference Study (MGRS) South American site was Pelotas, Brazil. Pelotas is in the state of Rio Grande do Sul in the southernmost region of Brazil. The city has approximately 330,000 inhabitants. It has a highly experienced Epidemiology Research Center, with internationally recognized expertise in longitudinal studies of maternal and child health nutrition [1, 2].

Among the site selection requirements for the MGRS was that social and environmental conditions experienced by the study sample permit unconstrained growth in early childhood [3, 4]. Data from all children born in Pelotas in 1993 [2] were analyzed to identify a socioeconomic cutoff above which children in Pelotas have a prevalence of stunting of 2.3% based on the current international reference [5]. These analyses demonstrated that children in this community from families whose monthly incomes are at least six times the minimum monthly wage (approximately US\$600) have a stunting rate of 2.5% [6]. This cutoff was used to define socioeconomic eligibility for the sample from this site.

Breastfeeding rates were known to be low from previous research conducted by the research team. However, their experience also demonstrated that baseline breastfeeding initiation and continuation rates could be improved substantially with adequate breastfeeding promotion.

This site piloted the MGRS protocol, and its experiences were of particular value in the implementation of the study in other sites.

Planning phase

Study timeline and preparatory activities

The MGRS protocol is summarized elsewhere in this supplement [3]. The study timeline of the site is summarized in figure 1.

The required sample size necessitated the successful recruitment of approximately 6 infants per week to achieve a longitudinal sample size of 300 within 12 consecutive months. The 1993 study [6] referred to above was used to estimate the prevalence of other MGRS exclusion criteria within the group of mothers whose income met or exceeded the socioeconomic criterion used to define eligibility (table 1).

The sample for the longitudinal component of the study was recruited from the Santa Casa de Misericórdia, Beneficência Portuguesa, and São Francisco de Paula hospitals. The three hospitals were visited by the study coordinator to explain the objectives of the study and procedures and request authorization for data collection in each facility. A meeting was held for all pediatricians practicing in the city to explain the goals of the study and request their collaboration, especially concerning the promotion of breastfeeding. Letters also were sent to each participating child's pediatrician asking for their support and offering lactation counseling services to their practices.

TABLE 1. Prevalence estimates of exclusion criteria based on the cohort of children born in Pelotas, Brazil in 1993

Exclusion criterion	Prevalence (%)
Gestational age less than 37 weeks	7.3
Maternal smoking	23.8
Admission to intensive care unit	2.2
Admission to nursery ward	3.2
Twin birth	2.3
Nonintention to breastfeed for at least 12 months	25.9
Any of the above	50.2

Institutional ethical approvals were obtained from the Ethical Committee of the Federal University of Pelotas.

Study teams

Six teams were set up to implement the longitudinal and cross-sectional components of the study: the screening, lactation counseling, follow-up, cross-sectional, coordination, and data management teams. The composition and coordination of the teams are summarized in figure 2. Participation in any team was not exclusive, so, for example, the same interviewers

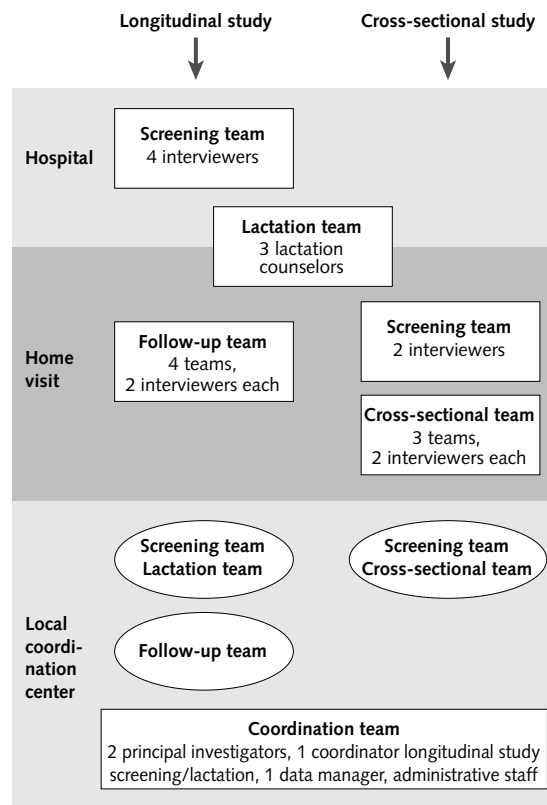


FIG. 2. Composition and coordination of study team

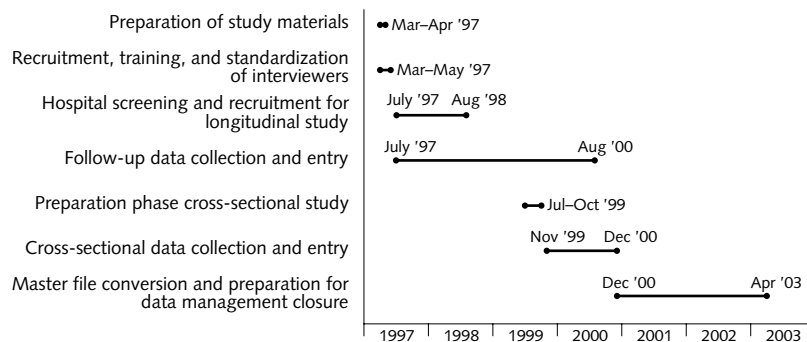


FIG. 1. Study timeline

participated in the longitudinal and cross-sectional components of the study. All follow-up and cross-sectional team interviewers worked full-time on the project. With one exception, all had college degrees, six of them in nutrition.

The screening team, composed of four interviewers and one supervisor responsible for quality control in the hospitals and for reviewing the questionnaires for completeness and accuracy, was in charge of screening all mothers in the hospitals to determine eligibility. The lactation counseling team included a senior lactation consultant and three registered nurses, one of whom made the first visit while the mother was in the hospital. The follow-up team included four groups of two interviewers each and one fieldwork supervisor. The cross-sectional team included two screeners and three pairs of interviewers. At the coordination level there were two local principal investigators (one of whom coordinated the follow-up and cross-sectional studies), one coordinator for the screening and lactation teams, and two administrative staff members. The data management team was composed of one data manager and two data entry clerks.

Training and initial standardization

Fourteen female candidates were screened. After detailed explanations of the project and anthropometric training had been provided to each of them, 11 were recruited. Each of the 11 team members participated in the initial anthropometric standardization session conducted by one of the two WHO-designated lead anthropometrists. Based on the results of this standardization session, the eight interviewers who performed best were selected.

Members of the lactation support team completed the 40-hour WHO lactation support training course [7]. This course was provided by two International Board Certified Lactation Consultants.

Adaptation of study materials and procedures

Brazil was the first country to begin data collection; the original forms and operational manuals for the longitudinal study were developed in Portuguese for pretesting at this site. They were later translated and adapted by the other MGRS sites, as described in the methodological paper in this supplement [3]. The instruments for the cross-sectional component were written originally in English, and therefore the standard translation procedure was used in adapting them [3].

The reluctance of some mothers to undress their infants completely for weighing in winter was anticipated. Therefore, samples of children's clothes were weighed and a list of clothing weights was prepared. This list was used to correct weights of partially or

completely dressed children. A similar list was compiled for parents' clothing. A list of the main brands of infant formulas used by this community was also prepared for coding nonhuman milk intakes. A list of vitamin and mineral supplements was developed to help mothers identify the brand names of products they used and/or provided to their infants.

Public relations activities

The success of the study required the close collaboration of the city's hospitals, doctors, and families. This required that attention be paid to public relations activities. These activities included visits to the three hospitals involved by the study coordinators, with lectures on the rationale for the study and the need to promote and support breastfeeding; donation of medical textbooks to the hospitals; breastfeeding lectures, to which all pediatricians in the city were invited; an initial study newsletter that included reprints of WHO Feeding Recommendations [8]; distribution of breastfeeding promotion leaflets to all mothers giving birth in the study hospitals (whether or not they fulfilled the eligibility criteria); regular newsletters to all pediatricians and other doctors of participating families that included breastfeeding information and feedback from the study; study advertisements in local newspapers; and regular publication of articles on the study and/or breastfeeding in local newspapers.

Maintaining excellent rapport between interviewers and families was viewed as essential to the success of the study. The role of the interviewer's attitude and perceived friendliness and helpfulness was stressed. Small gifts, such as infant participation diplomas on which infant weights were recorded and a photo album delivered at the infant's first birthday, were also designed to demonstrate to families how much their help was appreciated. Additionally, on their second birthday, children who participated in the longitudinal study received a T-shirt with the WHO logo and the statement "I participated in the International Multicentre Growth Reference Study."

Implementation of the longitudinal study

Sampling strategy

All women who resided in Pelotas and delivered at one of the three hospitals listed above, who gave birth to a full-term singleton, and whose baby was not admitted to a nursery or child intensive care unit for more than 24 hours were interviewed from July 1997 to August 1998. For convenience, only deliveries taking place between 6 pm Sunday and 6 pm Friday were screened. Analyses of the 1993 cohort data set showed no differ-

ences between babies born on weekdays and weekends (e.g., in rates of vaginal deliveries).

Screening and enrollment of children

All enrolled infants met the eligibility criteria outlined in the MGRS protocol [3]. Other selection criteria specific to this site are shown in table 2. The exclusion criterion “mother planning to stop exclusive breastfeeding before four months” in the MGRS protocol was not applied, because local data showed that the intended duration of exclusive breastfeeding—as reported soon after delivery—is unrelated to actual duration. Estimates of gestational age were based on ultrasound measurements; the interviewers carried gestational age calculators to assist with this estimate. The study supervisor subsequently checked all calculations [9]. If no ultrasound examination was available, the date of the last menstrual period was used to estimate gestational age. If neither the last menstrual period nor an ultrasound examination was available, and the child fulfilled all other eligibility criteria, the screening coordinator (a pediatrician) was contacted immediately. The pediatrician estimated the infant’s gestational age by the Dubowitz method [10].

At the end of the interview, mothers with eligible infants were invited to participate in the study. Consent obtained in the hospital was regarded as preliminary. Written consent was obtained during the first home visit.

Follow-up logistics

Pelotas was subdivided into four areas. Each was assigned to a pair of interviewers on the follow-up team. The four pairs of interviewers conducted follow-up visits and obtained all measurements for the longitudinal component of the study. Each team was organized so that one of the interviewers was fixed and the other was rotated every two months. This rotation among teams was designed to minimize systematic errors caused by reinforcement of faulty techniques and also allowed the comparison of measurements among distinct interviewer pairs. The consistency of

TABLE 2. Longitudinal study selection criteria specific to the Brazilian site

Criterion	Operationalization
Perinatal morbidity	Absence of significant perinatal morbidity (newborns with postnatal stay in intensive care > 24 hours excluded)
Intention to breastfeed	Mothers who expressed intention to breastfeed, regardless of duration
Socioeconomic criteria	Family income at least US\$600 per month

one interviewer visiting any given subject helped ensure good rapport with mothers and children.

During the first home visit, at 14 days, the interviewers explained the schedule and methods of the study to the mothers and the importance of their participation. The study forms completed in the follow-up visits have been described elsewhere in this supplement [3]. The interviewers returned the completed questionnaires to the local coordination center twice a week.

Decisions by one or both parents to leave the study were reported immediately to the study coordinator, who immediately contacted the mother to review the reasons for this decision. The coordinator outlined the requirements of the study to ensure that the decision was a well-informed one.

To assess the possibility of selection bias, it was important to have information on mothers and infants who refused to participate or who dropped out of the study [3]. Attempts were made to locate by telephone the families of all children who were designated as eligible during the hospital screening, but who, for various reasons, were not participating at age 12 months. A home visit was scheduled for all who consented to participate in the 12-month study [3].

Lactation support team and complementary feeding

In addition to the initial hospital lactation counseling visit, the lactation support team made home visits at 5, 15, 30, and 45 days and at 2, 3, 4, 6, 8, 10, and 12 months after delivery. Extra visits were conducted whenever there were problems requiring further attention, such as cracked nipples. Telephone calls were made at 5, 7, 9, and 11 months after delivery to assess how breastfeeding was proceeding. Additional visits were scheduled on the basis of these inquiries.

The first hospital visit included advice on the advantages of breastfeeding; nursing was observed, and correction of the baby’s position was advised if necessary; instructions on how to express milk manually were given, and a breastfeeding promotion leaflet was distributed. The home visits included the same content. When the infant was six months of age, the mother received advice on the need to introduce complementary feeding, and on recommended foods [8] (table 3).

One lactation counselor was assigned to each mother throughout the study. On average, each lactation counselor was responsible for visiting two newly enrolled mothers per week. The lactation support team coordinator visited each enrolled mother at least once during the study. She also accompanied lactation counselors in their visits whenever there were particularly difficult lactation problems.

A telephone hotline was maintained 24 hours a day, seven days a week, to assist mothers who experienced

TABLE 3. Complementary feeding guidelines at the Brazilian site

Age (mo)	Recommendations
0–5	Breastfeed Do not give teas, water, or other types of milk or food
6–11	Breastfeed Introduce complementary foods, with emphasis on Meat Eggs Fruits and vegetables (mainly yellow) Mashed beans Avoid diluted foods with high water content Use cup and spoon, not baby bottles Start with 1 complementary feed per day and increase to 3 feeds per day
12–23	Breastfeed Give complementary foods at least 5 times a day Family foods should be the main type of food

particularly severe problems. The hotline number was provided to all mothers and to their pediatricians.

Implementation of the cross-sectional study

Sampling strategy

The cross-sectional study was designed as a “panel study” in which children aged 18 to 71 months were enrolled and visited up to three times, at three-month intervals. This was aimed at increasing the number of available measurements. Children who reached the age of 72 months during the implementation of the cross-sectional study were visited only once or twice.

The sampling strategy of the cross-sectional component was designed to obtain a sample of children aged two to five years who were similar to children enrolled in the longitudinal component. To accomplish this aim, the addresses of children taking part in the longitudinal study were plotted on a city map. The homes of index children were used as points of departure for identifying participants in the cross-sectional component. The interviewers were instructed to move in a clockwise direction relative to the index child’s household. The interviewers visited all houses or apartments on blocks shared by the index households until three children within the required age group were located. If three eligible children were not located in the first block, the interviewers moved to another previously defined block in the same neighborhood. The neighbors were asked to provide information concerning any child

under age 10 living in homes with whom contact could not be made. The age of 10 was selected to provide a margin of safety in order not to miss potentially eligible children. If two different neighbors provided consistent information that no children under 10 lived in the targeted home, the home was excluded. In doubtful cases, the interviewers revisited the home in question. When children aged 18 to 71 months were identified, a screening questionnaire was administered to a responsible caregiver. If the child fulfilled all eligibility criteria, the mother or guardian was invited to participate in the study. Appointments for consenting children were made to obtain anthropometric measurements. Children who were enrolled or had participated in the longitudinal component of the study were ineligible for the cross-sectional component.

Standardization, quality control, and data management activities

Standardization sessions

Anthropometry standardization procedures followed the MGRS protocol [11]. Initial practice sessions were conducted at two municipal day-care centers. Subsequent anthropometric standardization sessions were conducted with 17 children under three years of age at one of the two day-care centers in which initial training was conducted. Each of the study anthropometrists measured the same child twice, as did the local lead anthropometrist. The local lead anthropometrist’s measurements were regarded as “reference values.” Nineteen standardization sessions were carried out, one every two months, in addition to the initial standardization session held by one of the two WHO-designated MGRS lead anthropometrists. Intra- and interobserver technical errors of measurement (TEM) were calculated for each fieldworker from data collected in these standardization sessions.

The motor development component of the MGRS was not performed at this site, so no standardization sessions related to this component were scheduled.

Quality control activities

The interviewers returned the completed questionnaires to the site’s coordinating center within four days of all interviews. The questionnaires were reviewed and open questions were coded by the relevant team’s supervisor. Problems encountered at this stage were discussed at the next team meeting to permit the group to review all discrepancies, allow agreement to be reached on how each discrepancy should be resolved, and identify how best to prevent the recurrence of similar problems. After appropriate follow-up was

completed, any required corrections were made, and the questionnaires were forwarded to the data manager for double data entry. Team meetings were scheduled at two-week intervals throughout the study.

Quality control questionnaires that repeated questions about morbidity, vitamin or mineral supplement intake, maternal work, and child feeding were administered to 20% of mothers visited each week. To determine which mothers would be reinterviewed, a list with the numbers of the questionnaires completed during the week was prepared, and 20% were selected randomly. The quality control interview was carried out by telephone by the quality control staff, one to two days after the actual interview.

Calibration of equipment was conducted as outlined in the MGRS measurement and standardization protocols [11].

Data management

Data management in Pelotas differed from that at other MGRS sites. This was partly because Pelotas served as the MGRS pilot site. Data collection was started before data entry routines used in the other sites had been fully developed at the WHO Coordinating Centre in Geneva.

All databases in the longitudinal study were originally created using Epi Info software [12]. All data were entered twice; comparison of the two files allowed the correction of data entry errors. Data cleaning procedures were conducted separately for each file. In order to adapt these databases to the MGRS master file structure, all variables were renamed and reformatted using SPSS 8.0 for Windows software. After this process, all data files were satisfactorily incorporated into the master files at the WHO Coordinating Centre [13].

References

1. Barros FC, Victora CG, Vaughan JP. The Pelotas (Brazil) Birth Cohort Study 1982–1987: strategies for following up 6000 children in a developing country. *Paediatr Perinat Epidemiol* 1990;4:267–82.
2. Barros FC, Victora CG, Vaughan JP, Tomasi E, Horta BL, Cesar JA, Menezes MB, Halpern R, Post CL, del Mar Garcia M. The epidemiologic transition in maternal and child health in a Brazilian city, 1982–1993: a comparison of two population-based cohorts. *Paediatr Perinat Epidemiol* 2001;15:4–11.
3. de Onis M, Garza C, Victora CG, Onyango AW, Frongillo EA, Martinez J, for the WHO Multicentre Growth Reference Study Group. The WHO Multicentre Growth Reference Study: planning, study design, and methodology. *Food Nutr Bull* 2004;25(1)(suppl 1):S15–26.
4. Garza C, de Onis M. A new international growth reference for young children. *Am J Clin Nutr* 1999;70(suppl 1, part 2):169S–72S.
5. National Center for Health Statistics. Growth curves for children birth–18 years, United States. *Vital and Health Statistics, Series 11, No. 165*. Department of Health, Education, and Welfare Publication No. PHS 78–1650. Washington, DC: Government Printing Office, 1977.
6. Post CL, Victora CG, Barros FC, Horta BL, Guimarães PRV. Desnutrição e obesidade infantis em duas coortes de base populacional no sul do Brasil: tendências e diferenciais. *Cadernos de Saúde Pública* 1996;12(suppl 1):49–75.
7. World Health Organization/United Nations Children's Fund. Breastfeeding counselling: a training course. Documents WHO/CDR/93.3-6 and UNICEF/NUT/93.1-4. Geneva: World Health Organization, 1993.
8. Giugliani E, Victora CG. Normas alimentares para crianças brasileiras menores de dois anos (bases científicas). Brasília, Brazil: Organização Panamericana de Saúde/Organização Mundial de Saúde, 1997.

Conclusions

The MGRS is a complex study that required careful planning and implementation. The research team in Brazil gained much experience both from the methodological aspects of this study and from interaction with the other participating centers. The site's major challenges were related to breastfeeding. The lactation support team experienced the greatest turnover, and securing the adherence of local pediatricians to the feeding recommendations of the study was often difficult. The high turnover of the lactation support team was probably a result of team members' clinical responsibilities related to their ancillary nursing duties. These affected their availability to make home visits to, and receive telephone calls from, participants who experienced breastfeeding problems.

Another important challenge was that some of the city's pediatricians were not supportive of current feeding recommendations. Mothers were often encouraged to administer teas, water, and/or juice to their infants starting at one week of age. The pediatricians often recommended formula feeding at the earliest sign of any breastfeeding difficulty. Pediatricians also commonly had little, if any, knowledge about lactation support. Letters, reprints and other educational material sent to selected physicians were inconsistently effective in changing practices. It was not uncommon for mothers to contact a lactation consultant immediately after appointments with their pediatricians to check if advice they had just received was consistent with the recommended practices of the study. Despite these constraints, lactation support was highly successful: whereas prior to the study about 18% of mothers who fulfilled the inclusion criteria breastfed for one year, this proportion almost doubled in the MGRS.