ISSN 1415-5273

Volume 26 | Número 2

Março - Abril • 2013

Revista de Nutrição

Brazilian Journal of Nutrition

Revista de Nutrição é continuação do título Revista de Nutrição da Puccamp, fundada em 1988. É uma publicação bimestral, editada pela Pontifícia Universidade Católica de Campinas. Publica trabalhos da área de Nutrição e Alimentos.

Revista de Nutrição is former Revista de Nutrição da Puccamp, founded in 1988. It is a bimonthly publication every four months and it is of responsibility of the Pontifícia Universidade Católica de Campinas. It publishes works in the field of Nutrition and Food.

INDEXAÇÃO / *INDEXING*

Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), *CAB Abstract, Food Science and Technology Abstracts, Excerpta Medica, Chemical Abstract,* SciELO, *Popline, NISC, Latindex, Scopus, Web of Science*. Fator de Impacto / *Factor Impact* JCR: 0,156.
Qualis: B1

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ISSN 1415-5273

Revista de Nutrição

Brazilian Journal of Nutrition

Revista de Nutrição é associada à
Associação Brasileira de Editores Científicos
ABEC

FICHA CATALOGRÁFICA

Elaborada pelo Sistema de Bibliotecas e
Informação – SBI – PUC-Campinas

Revista de Nutrição = Brazilian Journal of Nutrition. Pontifícia Universidade Católica de Campinas. Centro de Ciências da Vida. Faculdade de Nutrição. – Campinas, SP, v.16 n.1 (jan./mar. 2003-)

v.26 n.2 mar./abr. 2013

Semestral 1988-1998; Quadrimestral 1999-2002; Trimestral 2003-2004; Bimestral 2005-
Resumo em Português e Inglês.
Apresenta suplemento.
Continuação de Revista de Nutrição da PUCCAMP 1988-2001 v.1-v.14;
Revista de Nutrição = Journal of Nutrition 2002 v.15.
ISSN 0103-1627
ISSN 1415-5273

1. Nutrição – Periódicos. 2. Alimentos – Periódicos. I. Pontifícia Universidade Católica de Campinas. Centro de Ciências da Vida. Faculdade de Nutrição.

CDD 612.3

ISSN 1415-5273

Artigos Originais | *Original Articles*

Breastfeeding promotion and support strategies based on Paulo Freire's epistemological categories[1]

Estratégias de promoção à amamentação centrada nas categorias epistemológicas de Paulo Freire

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ABSTRACT

Objective

This study identified strategies for promoting breastfeeding involving pregnant women, breastfeeding women and actors of the social support network for the breastfeeding process.

Methods

This qualitative study was guided by action research and the focal group technique to collect data. Focal Group 1 consisted of four pregnant and six breastfeeding women; Focal Group 2 consisted of six family members; and Focal Group 3 consisted of thirteen health professionals. The focal groups were guided by the following questions: What breastfeeding promotion and support actions should be done? How should they be performed? Who should perform them? The conversation sunder went thematic content analysis and were interpreted in the light of Paulo Freire's theoretical constructs: dialogue, ethics and problematization.

Results

Four themes were emerged from the conversations: dialogue-based educational actions involving the social support network during the vital cycle; educational actions in schools; educational actions in the media; ongoing counseling at Family Health Units.

[1] Article based on the thesis of FMP LINHARES intitled: "Breastfeeding promotion in the light of Paulo Freire" (Promoção da amamentação à luz do referencial de Paulo Freire). Universidade Federal de Pernambuco; 2011.

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Conclusion

The constructed strategies were centered on dialogue and active listening. Both should be present during the entire vital cycle and in the Family Health Strategy, and involve all actors of the social support network. These strategies may disrupt the unidirectional transmission of the educational practices that promote breastfeeding.

Indexing terms: Breast feeding. Family health. Health education. Health promotion.

RESUMO

Objetivo

Identificar estratégias de promoção ao aleitamento materno envolvendo gestantes, nutrizes e atores da rede de apoio social no processo da amamentação.

Métodos

Estudo qualitativo conduzido pela pesquisa-ação utilizando a técnica do grupo focal para a coleta de dados. Participaram do Grupo Focal 1, 4 gestantes e 6 nutrizes, do Grupo Focal 2, 6 familiares e do Grupo Focal 3, 13 profissionais da saúde. Os grupos focais foram guiados pelas seguintes questões norteadoras: Quais as ações de promoção e apoio à amamentação que devem ser realizadas? Como devem ser realizadas? Quem deve realizá-las? As falas foram submetidas à análise de conteúdo, na modalidade temática e interpretadas à luz dos constructos teóricos de Paulo Freire: diálogo, ética e problematização.

Resultados

Da análise das falas emergiu quatro temas: ações educativas centradas no diálogo, envolvendo a rede de apoio social durante o ciclo vital; ações educativas nas escolas; ações educativas inseridas nos meios de comunicação; aconselhamento contínuo na Unidade de Saúde da Família.

Conclusão

As estratégias construídas foram centradas no diálogo e na escuta ativa, que deverão estar presente em todo o ciclo vital e, na Estratégia Saúde da Família, com envolvimento de todos os atores da rede de apoio social. Estas estratégias poderão romper a transmissão vertical da prática educativa na promoção do aleitamento materno.

Termos de indexação: *Amamentação. Saúde da família. Educação em saúde. Promoção da saúde.*

INTRODUCTION

Global actions to encourage breastfeeding are supported by three pillars: promotion, support and protection. Important breastfeeding promotion actions are the World Breastfeeding Week, National Human Milk Donation Day and the Human Milk Banks Network[1]. In 2008, the Brazilian Ministry of Health launched a new strategy for promoting breastfeeding in primary care, the Breastfeed Brazil Network, which proposes an interdisciplinary work based on the principles of ongoing education[2].

The pro-breastfeeding actions are a reality in the world and Brazil. However, these strategies are generally guided by knowledge produced exclusively by health professionals through unidirectional educational actions, reinforcing the idea that the mother is the only person responsible for the breastfeeding practice[3]. Generally, effective discussion with the protagonists of this practice does not happen and breastfeeding promotion policy is permeated by the attempt to shape the woman's behavior for her to choose to breastfeed.

Consequently, participative educational actions could promote reflection and allow the relevant actors to participate more actively. This requires guiding the experiences, knowing how to listen and showing mutual respect. This process will promote the creation of bonds and conscious decision making without imposition[4].

In this sense, dialogue is a powerful tool for transforming human beings into active individuals, authors of their own story. In dialogic

education practice, people are available for listening and interpersonal relationships are bidirectional, participative and humanized. In this space, one who teaches is dialectically educated because knowledge is not singular. Different bits of knowledge complement each other, often giving a sensation of unfinishedness, since there is always something requiring reformulation[5]. Therefore, daily life experiences are problematized in this collective construction and should be the starting point for knowing reality, and for unveiling and interacting with the world of the individuals involved. This is possible thanks to intercommunication in the educational process[4].

Ethics is present in educational action when health professionals provide a democratic environment, free from prejudice and discrimination. Participants' opinions are respected and everyone is seen as social individuals who have their own values, habits and culture[6].

As a result, it is important to create breastfeeding promotion strategies that have been previously discussed with pregnant women, breastfeeding women, family members and health professionals. Incorporation an approach that emphasizes experiences and bits of knowledge of the people involved is a necessary stimulus for individual and group change.

In this process, dialogue, problematization and ethics are essential for identifying the impressions, opinions, feelings and bits of knowledge of the social actors. These Freirean suppositions propose a new pedagogical concept, recognizing the historical, social, political and economic character of those involved[4].

Considering these aspects, the present study aims to identify breastfeeding promotion strategies that involve pregnant women, breastfeeding women and social support network actors in the breastfeeding process.

METHODS

This is a descriptive, exploratory study using the qualitative approach done in the Family Health Unit João Rodrigues in the city of *Recife* (PE), Brazil. The participants were health professionals, pregnant women, breastfeeding women and family members of the latter two. This study is part of a research action called "Breastfeeding promotion in the light of Paulo Freire", and followed the methodological sequence suggested by Le Boterf[7] for participatory research.

Action research is a type of social research linked to actions required to solve a public problem. These actions are developed by the study researchers and participants together and are grounded on co-responsibility[8].

An initial survey was done with 30 health professionals, 101 breastfeeding women, 66 pregnant women and 26 family members to identify their socioeconomic and cultural profiles, experiences, feelings and theoretical knowledge about breastfeeding and to assess their professional breastfeeding promotion practices.

The results of this preliminary survey were presented at a meeting with the participants that showed up at the previously arranged location, time and date. The information was disclosed separately to the health professionals and to the other participants, namely the pregnant and breastfeeding women and their family members. Three focal groups were structured from these meetings for the critical analysis of the problems considered priorities, corresponding to Le Boterf's[7] third phase. Focal group is a special type of group whose main objective is to encourage the participants to discuss a certain issue. It is the ideal technique for exploring experiences, opinions, concepts and group construction[9].

The Focal Group 1 (FG1) consisted of four pregnant women and six breastfeeding women. The Focal Group 2 (FG2) consisted of six family members of the pregnant and breastfeeding women. The Focal Group 3 (FG3) consisted of thirteen health professionals of whom seven were community health agents, two were nursing assistants, three were nurses and one was a physician. Participant recruitment took into

consideration their interest on the theme and desire to contribute to the transformation of the practice.

The focal groups met between August and October of 2009 in the hall of the local church and each session lasted on average one and a half hours. The number of focal group sessions was established by the information saturation criterion[10], so four sessions took place. The focal group consisted of one moderator, one observer and one reporter. The function of the moderator was to coordinate the group and keep the participants focused on the study theme. The observer was responsible for taking down the verbal and nonverbal behaviors during the sessions and the reporter was in charge of taping the discussion using a digital voice recorder[9].

At the beginning of the first session of each group, the moderator introduced himself and the other two collaborators of the team (observer and reporter) and disclosed the objectives of the study and focal group. Next, the moderator asked the participants for permission to tape the session, guaranteeing the anonymity of the collected information. A verbal agreement was established with the participants where all of them agreed to listen carefully to each other, take turns talking, not discuss the content of the focal group session elsewhere and respect everyone's opinions and feelings.

A photograph of a singer breastfeeding was used for introducing the theme, beginning the construction and association of ideas and encouraging group participation. The discussion was guided by the following questions: *What breastfeeding promotion and support actions should be done? How should breastfeeding promotion and support actions be performed? Who should perform them?* After each session, the entire session was transcribed. Next, the transcriptions and collected information were read and reread. The statements were understood and analyzed under a single context based on meaningful and repeated words and phrases. The core meanings were condensed and codified. These codifications emerged as subcategories and thematic categories[11].

Paulo Freire's epistemological categories - dialogue, ethics and problematization - permeate the shared process of constructing breastfeeding promotion and support strategies, helping to interpret the themes[4].

This study was approved by the Hospital Agamenon Magalhães Research Ethics Committee under protocol number 150/08 in April 2008 and all participants signed a Free and Informed Consent Form, respecting the norms of Resolution 196/96 issued by the Human Research Ethics Committee of the National Health Council.

RESULTS

The women in FG1 were 14 to 36 years old. Five of them had not finished elementary school and nearly all of them were housewives. Their household incomes were at or below one minimum salary. FG2 consisted of six women, two mothers of pregnant women, one mother of a breastfeeding woman, two grandmothers of pregnant women and one friend of a breastfeeding woman. Their ages varied from 27 to 72 years. All were housewives with a household income of one minimum salary who had not finished elementary school. The ages of the health professionals in FG3 varied from 23 to 50 years. Twelve were females and one was male. Most had been working for more than five years in the Family Health Strategy.

Analysis of the conversations resulted in the extraction of four themes that contextualized the strategies for promoting and supporting breastfeeding, how they should be implemented and by whom.

Theme 1: Educational actions centered on dialogue involving the social support network during the vital cycle

The statements indicated that the breastfeeding promotion and support strategies

should be permeated by educational actions centered on guidance.

> [...] *guide, encourage, talk, teach, explain how to position the child to breastfeed* [...] GF1.
>
> [...] *guide this youth, teach them how to breastfeed, they need someone to guide them* [...] GF2.
>
> [...] *be advised about the things that will happen, also advise the mother, the neighbor, and also provide this information when the woman delivers the child* [...] GF3.

The testimonies revealed that the groups did not only want guidance, but also educational action based on counseling, that is, characterized by an interpersonal relationship permeated by dialogue and active listening, valuing the exchange of information and helping the user to make self-care decisions.

> [...] *that approached us in a more respectful manner... they only believe that you have the obligation to breastfeed... we should be able to say what we feel, what we think, and not only listen to what they say... sometimes you want to say something but are not given the opportunity* [...] GF1.
>
> [...] *we learn by asking, because one person speaking and everyone else listening does not work... everyone needs to speak up* [...] GF2.
>
> *[...] the greater focus should be the woman, prepare the woman differently, have people listen, pay attention to everything she says* [...] GF3.

The following statements evidenced that the educational actions within a dialogic context should be contemplated in the entire vital cycle, especially with teenagers pregnant for the first time:

> [...] *why not insert this (breastfeeding) early on, together with sexual education... since the beginning of prenatal care* [...] GF3.
>
> [...] *today all the 12-, 13-year old girls are getting pregnant. They need more guidance... also (provide guidance) to the mother, grandmother, even to the teenage mothers, first-time mothers, second-time mothers...* [...] GF2.

Bits of the conversations show that educational actions should be present in many scenarios, namely:

- Educational actions for promoting breastfeeding at home:

> [...] *(health agents) should visit pregnant women or those who just began to breastfeed. Health agents should go to their houses on the first 15 days of breastfeeding to help, preferably make many visits* [...] GF1.
>
> [...] *Home visits are good, but they have to be more practical, since one thing is someone talking, another is someone showing how it is done* [...] GF3.

- Educational actions for promoting breastfeeding during prenatal care visits:

> [...] *during the prenatal visits the nurses should show more, show a breast, show how it should be done* [...] GF1.
>
> [...] *during prenatal visits, health professionals should make an anamnesis of breastfeeding. Since the first prenatal care visits we can already start working, since pregnancy* [...] GF3.

- Educational actions for promoting breastfeeding in group meetings:

> [...] *gather women to talk, to teach a large group, each one sharing her opinion, women who are breastfeeding, who have already breastfed, who think about having children, those who are breastfeeding advising those who will breastfeed* [...] GF1.
>
> [...] *meetings like this one, with a lot of people to talk about breastfeeding, I could share my experience with other mothers* [...] GF2.

> [...] *I think it would be good for us to work with a group of pregnant women and show them how to breastfeed, the initial care, explain exclusive breastfeeding, through dynamic groups* [...] GF3.

When the participants were asked about who should be involved in the educational actions, it was clear that all the social support network actors should be involved.

> [...] *talk to relatives, friends, asking for help. The family... partner, mother, brother, sister* [...] GF1.
>
> [...] *health agents, nurses, everyone, the friends, grandmothers and healthcare facility physicians, asking for help especially for the mother and husband* [...] GF2.
>
> [...] *involve nurses, the entire team, relatives, pregnant and breastfeeding women, they could be multiplying agents (people who help to spread knowledge)* [...] GF3.

Theme 2: Educational actions at school

For the health professional focal group, school was an important place for the cultural dissemination of breastfeeding. Schools should be included among other spaces that promote and support breastfeeding, so that promotion and support beings during childhood:

> [...] *introduce a school program in elementary school, insert breastfeeding early in the school curriculum* [...] GF3.
>
> [...] *Why is it not part of the school curriculum? Promote breastfeeding in the school environment* [...] GF3.

Theme 3: Educational actions inserted in the media

The groups considered that the media should be used for promoting and supporting breastfeeding. Television is a channel that caries information quickly and is potentially one of the entities that most promotes behavioral changes:

> [...] *more dissemination and more television campaigns. In the radio, include breastfeeding information in soap operas* [...] GF1.
>
> [...] *I think television should be used more to talk about breastfeeding, today people watch a lot of television. The people do what the television tells them to do* [...] GF3.

Theme: 4 Counseling room in the Family Health Unit

Basically, all focal groups made clear that women need support and help with the specific breastfeeding challenges and self-consciousness crises. The statements showed the need of ongoing counseling and a place in Family Health Units for instructing women facing breastfeeding difficulties:

> [...] *there should be a room at the Family Health Unit for women who are having problems breastfeeding or who do not want to breastfeed, with a nurse helping, advising, teaching how to hold the baby, how to breastfeed* [...] GF1.
>
> [...] *If mothers had a problem and did not want to breastfeed, they could go to the Family Health Unit and get help* [...] GF2.

DISCUSSION

Educational action was the main focus of the breastfeeding promotion strategy at the public level chosen by the participants. This action should be planned by disrupting the unidirectional transmission of information. The relationship between user and professional, and common sense and interpersonal exchanges must be valued. Dialogue permeated by active listening should be an essential instrument in the entire communication process. Not basing the teaching-learning relationship on dialogue is unfeasible

because the human species cannot be mute, silent. Through the use of words, man can transform the world, moving from a naïve level of indignations, questionings and knowledge to a critical knowledge of reality[4].

Although the focal groups used the word "to guide" to describe the action, its meaning is linked to the unidirectional way in which teaching occurs, differing from the precepts of dialogic educational practice. The objective of this practice is not only to inform to promote health, but also to change the existing knowledge. Dialogic communication in educational health practice aims to build knowledge that allows individuals to choose the most appropriate strategies for promoting, maintaining and recovering their health. Dialogue promotes an exchange of technical, scientific and popular bits of knowledge that users and professionals can use to build greater knowledge together[12].

While attempting to build shared critical thought, spaces should be created to problematize bits of knowledge by reflecting about reality. Problematization seeks to overcome educational practices that are limited to the transmission of contents. This communication happens in a convergent manner, where all participants have the chance to share their experiences[4].

In the need of exchanging knowledge, one realizes the importance of the participation and involvement of the social support network in the educational actions that promote and support breastfeeding. The involvement of relatives, friends, community leaders, health professionals, and health, religious and political services can influence the mother's decision to continue breastfeeding[13,14]. The social support network is an important source of support both for the recent and more experienced mothers. Different types of support can be offered in different circumstances; support may come as an advice, some practical help or even some comforting words[15].

All actors of this study perceived the family as an active participant and also as a source of pressure on breastfeeding women. Even if, in some situations, the family does not have direct contact with health professionals, the mother's discourse allows health professionals to notice and infer that the family is responsible for the mother-oriented messages related to the breastfeeding course. These messages are disclosed as the dietary and other conditions of the child are processed, and sometimes become ambiguous and contradictory. Among the family members, it seems that the child's father and grandmother are the central actors in this process.

The active presence of the partner is recognized as a support and encouragement for the breastfeeding process, especially regarding the daily care given to the mother and child. By sharing the responsibilities, the partner may feel that breastfeeding is not exclusive to the mother, but part of the chores shared by the couple. Grandmothers also have an important role in supporting and encouraging breastfeeding when they consider breast milk an essential food for the health and development of the baby. Nonetheless, grandmothers often lead breastfeeding women to doubt that breast milk is capable of meeting all the nutritional needs of the child[16,17].

Dialogic educational actions covering the social support network cannot be confused with a mere negotiation among the parts, but a mobilization of people for a certain purpose. In this sense, the focal groups recommend that this mobilization should happen during home visits, since it is a way of bringing health professionals and users closer together. This visit is considered a space for listening and talking, a time of reception and bond creation, respecting the particularities of each family. The bond between health professionals and users emerges from the respect and trust built through constant contact and from gaining more awareness about the reality of the families, which provides a favorable environment for more humane care[18].

This respectful bond is essential when one intends to perform an educational practice based on ethical values, where the actors are supportive and join forces to find solutions to the problems at hand[6].

Prenatal visits were pointed out as one of the opportunities for health professionals to identify the risk factors for early weaning and simultaneously perform educational actions by demonstrating breastfeeding management. This time was recognized as a reception time, since it allows dialogue and the free expression of doubts, feelings and experiences. Hence, health professionals need to allow women to expose their concerns, fears and expectations, so that they may take actions to help women overcome the challenges that appear during the breastfeeding process[19].

Those who perform educational processes within this dialogic perspective help to strengthen the people with whom they interact. Only dialogue generates critical thinking capable of encouraging pregnant women to express their doubts and fears, and simultaneously help them to feel capable of being the agents of their own care, through critical and reflective analysis of their own problems[20].

In addition to turning prenatal care visits into a breastfeeding promotion scenario, the participants mentioned the need of group meetings, allowing women, together with the social support network, to benefit from participatory education. Group activities may give women the opportunity to share their experiences and expectations with respect to breastfeeding. The formation of breastfeeding support groups with people from the community is one of the steps of the *Iniciativa Unidade Básica Amiga da Amamentação* (IUBAAM), which aims to promote and support breastfeeding by mobilizing primary healthcare units to adopt the "*Dez Passos Para o Sucesso de Amamentação*"[21].

The suggested group meetings are similar to the culture circle instituted by Paulo Freire in the 1960s, as an instrument for learning and strengthening bonds through dialogue. Culture circle in the dialogic concept is a circular space for expressing the self. Therefore, it is a contemplative and participative space. It is a method of discussing a given topic using various forms of expression, aiming to exchange information democratically, efficiently and quickly, allowing the development of activities that promote its achievement. Therefore, this method opposes banking education, that is, one where knowledge is deposited without reflection and questioning[22,23].

Among breastfeeding promotion strategies, the suggestion of introducing educational actions in schools was also evidenced. This proposal of including health promotion strategies in the school curriculum is not new. Education and health have been coming closer together since the 1970s through legal instruments, such as the Alma Ata Declaration, Ottawa Conference and strategies such as the Family Health Program, among others. The sooner the importance of breastfeeding is internalized, more favorable and positive this practice becomes for the individual. Thus, it is essential to begin promoting breastfeeding during childhood. School is the main institutionalized environment of the pedagogic and teaching-learning process, of socialization and growth, where one acquires cardinal health-promoting values. Yet, for this to happen, the school curriculum needs to be flexible, the school staff needs to be trained and health professionals and the local community need to collaborate[24,25].

The use of the media was another strategy considered to have social impact for implementing educational actions. The media has much influence in people's minds and behaviors, contributing substantially to changes or maintenance of social values and practices[26].

The focal groups also talked about the need of counseling rooms available 24 hours a day at the Family Health Units to clarify doubts on breastfeeding management and difficulties.

Health professionals should give breastfeeding women the opportunity to obtain

counseling, giving them the strength to deal with pressures, increasing their self-confidence and self-esteem and preparing them for decision-making[27].

FINAL CONSIDERATIONS

Breastfeeding promotion and support strategies should be centered on dialogue and active listening and begin during elementary school. They should also always be present in the Family Health Strategy, involving all actors of the social support network in all visits done during the pregnancy-puerperal cycle. These strategies may disrupt the unidirectional transmission of educational breastfeeding practices and recognize that women and their families are knowledgeable and capable of establishing dialogue with the health service. Accordingly, breastfeeding promotion and support strategies can be used for planning educational activities and implementing new practices in primary healthcare units.

Research action contributed to a more comprehensive understanding of humanization in educational action, recognizing the need of changing the relationship between health professionals and users and learning that the dialogic model in educational actions corresponds to the more pertinent model for pro-breastfeeding activities.

COLLABORATORS

All authors participated in the study conception, data analysis and interpretation, and writing of the article. FMP LINHARES was responsible for developing the field work and collecting data.

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Received on: 31/10/2011
Final version on: 30/10/2012
Approved on: 12/11/2012

Qualitative evaluation of the menu and plate waste in public day care centers in *São Paulo* city, Brazil

Avaliação qualitativa do cardápio e desperdício de alimentos em creches públicas do município de São Paulo

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ABSTRACT

Objective

This study assessed menu quality and plate waste in public day care centers of *São Paulo* (SP), Brazil.

Methods

This cross-sectional study collected data from the nurseries of seven day care centers, totaling 366 children aged 12 to 36 months. Each day care center was assessed for three days, totaling 42 days and 210 meals. Menu quality was assessed by the Qualitative Analysis of Menu Preparations method (*Análise Qualitativa das Preparações do Cardápio*), adapted for day care centers, which provides nutritional and sensory criteria. Food waste was determined by the Plate Waste-Ingestion Index.

Results

The supply of vegetables was inadequate in more than 90% of the days, and the amount of leafy vegetables and high-sulfur foods met the recommended amounts on 50% of the days. The supply of sweets and foods containing trans fatty acids was considerable. The Plate Waste-Ingestion Index for daycare centers varied from 25% to 43%, and the Plate Waste-Ingestion Index for food items varied from 11% to 47%.

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Apoio: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior/Programa Institucional de Bolsas de Doutorado Sanduíche no Exterior (Processos nº 9029-11-7 e nº 9032-11-8).

Conclusion

The preparations served and serving sizes clearly need to be reviewed, and new menu creation strategies are needed to control food waste.

Indexing terms: Child day care centers. Food quality. Menu planning. School feeding. Waste of water.

RESUMO

Objetivo

Avaliar qualitativamente o cardápio e o desperdício de alimentos em creches públicas de São Paulo (SP).

Métodos

Este estudo é transversal e os dados foram coletados nos berçários de 7 creches, que atendiam 366 crianças entre 12 e 36 meses. Cada creche foi avaliada durante 3 dias, totalizando 42 dias e 210 refeições. A qualidade do cardápio foi avaliada segundo o método Análise Qualitativa das Preparações do Cardápio, adaptado à realidade de creches, que estabelece critérios nutricionais e sensoriais. Foi avaliado o desperdício de alimentos pelo Índice de Resto-Ingestão.

Resultados

Os resultados refletiram que a oferta de legumes e verduras foi insuficiente em mais de 90% dos dias e, a quantidade de folhosos e alimentos ricos em enxofre foi compatível com o recomendado em metade dos dias, sendo expressiva a oferta de doces e alimentos contendo ácidos graxos trans. O Índice de Resto - Ingestão variou de 25% a 43% nas creches e de 11% a 47% nos alimentos analisados.

Conclusão

Evidencia-se a importância de revisão das preparações servidas e porcionamento dos alimentos, sendo necessária a adoção de novas estratégias na elaboração dos cardápios, visando o controle do desperdício alimentar.

Termos de indexação: *Creches. Qualidade dos alimentos. Planejamento de cardápio. Alimentação escolar. Desperdício de alimentos.*

INTRODUCTION

Children's growth and development are not only influenced by appropriate nutrition but also by the establishment of healthy food preferences and eating behaviors, built daily at home and day care centers, in the context of food selection, preparation and supply[1].

In Brazil, more than two million children are enrolled in day care centers, also known as Child Education Centers (*Centro de Educação Infantil* - CEI), where they stay from 10 to 12 hours a day and receive five meals a day[2]. All CEI children are covered by the National School Food Program (*Programa Nacional de Alimentação Escolar* - PNAE) which establishes that menus should provide 70% of the nutritional requirements of the children who stay at CEI full time[3]. A social investment of R$150 million is needed to feed the two million children enrolled in day care centers[4].

Despite the numerous programs and guidelines that aim to protect children at school, studies around the world show that it is very challenging to meet the proposed norms, often resulting in inadequate nutritional supply[5,6].

Given the multimillionaire PNAE investment, it is important to investigate and quantify plate waste, since it affects the cost-benefit of the served meals and calls attention to possible failures in menu creation, food selection and preparation, and the individual portion size used in the facility[7].

Brazil is one of the ten countries that most waste food, discarding annually the equivalent of R$12 billion, which is enough to feed roughly R$30 million people, or eight million families[8].

The waste chain extends from harvest to the consumer's table, where waste plate-ingestion is the ratio between the food left on the plate by

the consumer and the amount of food offered. In healthy populations, the acceptable plate waste limit is 10%[9].

Poulain & Proença[10] argue that for a food to sustain life, it needs not only nutritional quality, expressed by its carbohydrate, protein, fat, vitamin and mineral contents, but also familiarity and acceptance by the individual and social group. Food should have four essential functions: nutritional, hygienic, hedonic and social. Hence, aspects such as taste, color, shape, aroma, texture, temperature, serving time, and eating environment, among others, are components that need to be taken into account by nutritional approaches and assessments of meal acceptance.

Therefore, Veiros & Proença[11] developed the method (*Avaliação Qualitativa das Preparações do Cardápios* - AQPC) for analyzing menu quality in terms of menu items and their nutritional and sensory aspects. The method was adapted by Menegazzo *et al.*[12] to the CEI reality according to the PNAE and *Guia Alimentar para a População Brasileira*[3,13].

With this context in mind, the objective of the present study was to make a qualitative assessment of the nutritional and sensory aspects of day care center menu preparations and quantify the plate waste of children that attend public day care centers in the municipality of *São Paulo* (SP), Brazil.

METHODS

This study is part of the project "Efficient Day care Center Project (*Projeto Creche Eficiente*): Impact of training public/philanthropic day care center educators on hygiene and dietary practices and on suckling infants' health and nutrition", which aimed to train, improve and update daycare center educators on the health and nutrition care given to suckling infants and assess the knowledge they gained with respect to their work. Day care center selection and the assessment criteria are described in another publication[14]. Of the eight selected day care centers, one was excluded because it was not interested in participating in the study during the collection period of the data presented here.

The present study is a cross-sectional study done in the 14 nurseries of the selected day care centers. Data were collected from September to December 2010 by four graduate nutrition students of the *Universidade Federal de São Paulo* (Unifesp).

All day care centers that participated in this study has two nurseries (Nursery I and II) that run full time from Monday to Friday and serve five meals a day, namely breakfast, mid-morning snack, lunch, mid-afternoon snack and supper.

The menus of the meals served in the 14 nurseries of the selected day care centers were assessed on three nonconsecutive weekdays, corresponding to 42 assessed days and 210 meals.

Menu quality was assessed by the AQPC method adapted to CEI reality[12], which considers eight assessment criteria:

1. *Presence of fruits and fruit juices*: according to the recommendations, at least three fruit servings should be consumed per day[13,15]. Since children are also recommended to have one full meal at home[3], two fruit and/or natural fruit juice servings was considered adequate.

2. *Presence of vegetables*: analyzed in the same way as fruits since at least three vegetable servings should be consumed per day[13,15]. Two servings was considered adequate since that the child should have a third serving at home. Soups, chicken soup, pies and cakes, among others, that did not have a vegetable as the main ingredient were not counted.

3. *Presence of raw leafy vegetables*: at least one serving of raw leafy greens was considered adequate[12].

4. *Color monotony*: only lunch and supper were assessed since the other meals consisted of only two preparations with no variations. This

criterion was considered appropriate when at least 50% of the foods or preparations had different colors.

5. *Presence of high-sulfur foods*: since high-sulfur foods produce flatulence that may cause gastrointestinal discomfort and nuisance in the child[16], side dishes and salads were analyzed. This item was considered adequate when there was at most one high-sulfur food or preparation in the meal. The foods included in this assessment were avocado, chard, celery, peanuts, sweet potato, garlic, onion, walnut, broccoli, Brussels sprouts, cauliflower, peas, ginger, guava, jackfruit, lentils, apple, watermelon, corn, melon, mustard, turnip, nuts, egg, radish, cabbage and grapes. Beans were not included in this assessment since it should be consumed daily[13,15].

6. *Presence of sweets*: considering that the maximum recommended intake of sugars and sweets is one serving a day[13,15], a maximum of one serving was considered appropriate. This assessment included ready-to-eat preparations, such as chocolate milk, jelly, pudding, *dulce de leche*, cakes, and powdered fruit drinks with sugar as main ingredient.

7. *Presence of high-fat meats or deep-fried foods*: here, lunch and supper were assessed separately. This criterion was classified as appropriate when a maximum of 25% of the meats and hot side dishes offered during the day consisted of high-fat meats and deep-fried foods. High-fat meats were defined as meats with 50% of their energy contents coming from fats, namely filet steak, flank, sparerib, cover steak, rib, organ meats, tenderloin, beef clod and short plate[17].

8. *Presence of foods and/or preparations with trans fatty acids*: since there are no established upper safe limits for this nutrient[18], the absence of foods and preparations with this type of fatty acid was considered appropriate.

All preparations in the menu were first classified according to each of the criteria above. For this purpose, the Brazilian Food Composition Table (*Tabela Brasileira de Composição de Alimentos* - TACO)[19] and the nutrition facts labels of the processed foods were used. Next, the frequency of occurrence of the criteria expressed as percentage was determined for each day care center, considering the percentage adequacy of each one.

Food waste was quantified by the Plate Waste-Ingestion Index (PWI) given by the relationship between the Weight of the Plate Waste (WPW) and Weight of the Distributed Meal (WDM), and represented by the formula %PWI= WPWx100/WDM[7].

The weight of the distributed meals was determined by randomly collecting three servings of each food and/or preparation during distribution and calculating the mean amount served to each child. Next, the mean amount was multiplied by the number of children in each group. Second helpings were included in the calculations, thus giving the final weight of the distributed meals[7].

The weights and/or measurements of each food and/or preparation was obtained, corresponding to the WPW served during breakfast, mid-morning snack, mid-afternoon snack and supper, when it consisted of soup only. However, for lunch and occasionally supper, the analysis considered the %PWI per meal, because the foods and preparations were mixed on the plate[7].

The socioeconomic profiles of the children of the study institutions were determined by administering a questionnaire to their parents to determine the household income, which was determined by adding wages and other sources of income of all household members. The sum was expressed in *Reais* and converted to minimum salary units. The simple and percentage frequency distributions of the children's age, gender and socioeconomic class are described.

All data were input twice, and validated and analyzed by the statistical software Epi-Info 2000, version 3.4.3.

The project was approved by *Universidade Federal de São Paulo*'s Research Ethics Committee under protocol number 0442/10.

RESULTS

The socioeconomic characterization of the children enrolled in the study day care centers is shown in Table 1. Table 1 also shows that the gender distribution of the 366 children aged 12 to 36 months of the seven study day care centers was homogeneous. The household income of 62.8% of the families that use this service varies from one to three minimum salaries.

The meals were as follows: breakfast consisted of milk (pure, chocolate milk, cocoa composite milk or coffee composite milk) and bread (with margarine or jam or cream cheese (*requeijão*) alternating with plain cookies. The mid-morning snack consisted of a natural fruit juice with added sugar. Lunch consisted of rice and beans or pasta with beef, chicken or egg along with a raw salad and/or cooked vegetables, plus dessert (a fruit or sweet). The mid-afternoon snack consisted of only milk (pure, chocolate milk, cocoa milk composite or coffee milk composite). Supper was identical to lunch or consisted exclusively of soup and dessert (a fruit or sweet).

Table 1. Socioeconomic and demographic characteristics of the children attending public day care centers. *São Paulo* (SP), Brazil, 2010.

Variable	Day care centers															
	1		2		3		4		5		6		7		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age (months)																
12-24	38	49.4	24	54.5	30	50.8	28	43.1	7	31.8	25	46.3	8	17.8	160	43.7
24-36	39	50.6	20	45.5	29	49.2	37	56.9	15	68.2	29	53.7	37	82.2	206	56.3
Gender																
Female	35	45.5	20	45.5	23	39.0	24	36.9	10	45.5	22	40.7	21	46.7	155	42.3
Male	42	54.5	24	54.5	36	61.0	41	63.1	12	54.5	32	59.3	24	53.3	211	57.7
Household income (MS)[1]																
<1.0	1	1.3	6	13.6	7	12.1	5	7.8	1	4.5	2	3.8	3	6.7	25	6.9
1.0-2.0	23	29.9	26	59.1	19	32.8	21	32.8	7	31.8	21	39.6	19	42.2	136	37.5
2.0-3.0	26	33.8	5	11.4	18	31.0	18	28.1	2	9.1	10	18.9	13	28.9	92	25.3
>3.0	27	35.1	7	15.9	14	24.1	20	31.3	12	54.5	20	37.7	10	22.2	110	30.3

Note: [1]Minimum salary at the time of the study: R$510.00.

Table 2. Analysis of the menu offered in public day care centers: number of days in which each study criterion was appropriate. *São Paulo* (SP), Brazil, 2010.

Day care center	Menu days (n)	Fruits	Vegetables	Leafy vegetables	Colors (lunch/supper)	Sulfur	Sweets	Meats	*Trans* fatty acids	Adequacy by center	
										n	%
1	6	6	2	0	4	4	0	4	0	20	41.7
2	6	5	0	2	3	4	0	3	0	20	41.7
3	6	6	0	2	3	5	0	5	0	21	43.8
4	6	6	0	5	0	0	0	6	0	17	35.4
5	6	6	0	4	1	2	0	6	0	19	39.6
6	6	6	0	6	0	4	0	6	0	26	54.2
7	6	6	2	2	4	4	0	2	0	20	41.7
Adequacy n by	42	41	4	21	15	23	0	32	0	143	
Criterion %	100.0	97.6	9.5	50.0	35.7	54.8	0.0	76.2	0.0		42.6

Table 3. Plate Waste-Ingestion Index (PWI)[¶] of the different foods or preparations offered in public day care centers. *São Paulo* (SP), Brazil, 2010.

Day care	Plate waste-ingestion index (PWI) (%)									
	Milk[1]	Bread	Cookies	Fruit juices	Full meal[2]	Fruits	Sweets[3]	Milk[4]	Soup	Total Mean
1	37	42	23	10	35	33	11	21	17	25
2	49	62	51	4	35	26	19	21	15	34
3	57	66	39	36	58	39	9	31	no	43
4	37	24	50	19	49	51	11	28	35	34
5	50	18	50	16	48	44	5	57	no	37
6	77	33	59	17	31	27	no	41	no	41
7	24	35	18	22	29	22	no	30	39	28
Total Mean	47	40	41	17	41	35	11	33	27	34

Note: [¶]%IR= Weight of the Plate Waste (WPW) x 100/Weight of the Distributed Food (WDF); [1]Milk offered at breakfast, being either pure, chocolate milk, cocoa milk composite or coffee milk composite; [2]Lunch and supper; [3]Jelly, pudding, rice pudding, cake and processed sweet; [4]Milk offered at the mid-afternoon snack, being either pure, chocolate milk, cocoa composite milk or coffee composite milk; no - food not offered on the study days.

The soups offered on the study days were vegetable, bean, chicken and vegetable, and pasta soups.

Table 2 shows the number of days in which each of the analyzed criteria occurred. The supply of fruits was adequate in nearly all study days. On the other hand, the supply of vegetables was inadequate in more than 90% of the days, and the amounts of leafy vegetables and high-sulfur foods met the expectations in only 50% of the study days. The supply of sweets and foods containing *trans* fatty acids in the menu was considerable.

Food waste, expressed as percentage of plate waste-ingestion, is shown in Table 3, showing that in all institutions and for all study foods, the amount of plate waste exceeded the acceptable limit of 10%.

DISCUSSION

The supply of fruits was adequate because it was not in the menu of only one of the study days. Discordant results were found by Menegazzo *et al.*[12], who found that fruits were offered in the menus of CEI for children aged two to six years in only 4,0% of the study days and by Neelon *et al.*[20], who found that fruits were listed in the menus planned for children aged up to six years but were offered on only 14.4% of the study days.

Although the supply frequency was adequate, the amount of fruits offered may be inadequate, since PWI was 35%, emphasizing the importance of encouraging fruit intake through nutrition education measures starting in early childhood. Meanwhile, fruit juices had a lower PWI (17%). The ease with which juice can be consumed when compared with fruit, since it does not require chewing, may contribute to its better acceptance. On the other hand, juices contain fewer fibers and nutrients[21].

The supply of vegetables (9.5%) and raw leafy vegetables (50.0%) was inadequate. This is worrisome since the intake of these foods in Brazil has been declining, with a reduction of 5.0 to 8.0% between the years of 2003 and 2008, which is even more pronounced in lower-income families[22], the ones to which the study children belong.

The presence of vegetables, including raw leafy vegetables, varied from 0 to 100%, emphasizing the absence of standardization or compliance with the menu. Hence, some institutions offer vegetables daily while others do not.

Meals were considered adequately colorful on 35.7% of the study days and color-

monotonous meals were observed in the different day care centers 33.0% to 100.0% of the time. This variation may reflect the cook's creativity for preparing different foods and the need of training these professionals so that they may increase the attractiveness of a dish without changing the menu composition. The lunch and supper PWI was 41.0%; although this datum is multicausal, it may be affected by meal appearance, which may prevent acceptance by the children[15].

On 45.2% of the study days, too many high-sulfur foods were offered. Food with a high content of sulfur-containing amino acids increases the sensation of gastric discomfort because of gas production after the meals[16].

Sweets were offered on all study days and institutions. This is worrisome because sugar intake is associated with a general reduction in diet quality, early-onset overweight and obesity[23] and development of Non-Communicable Chronic Diseases (NCCD) and respective risk factors[24]. Additionally, excessive and frequent sugar intake promotes dental caries[25], which is aggravated by the absence of tooth-brushing in the CEI routine.

This criterion includes processed foods, such as sweets, chocolate milk, pudding and jelly, and the literature shows that this situation is also seen at home. While studying the ages in which foods are introduced to children that attend day care centers, Toloni *et al.*[26] found that more than 70% of the parents had offered sandwich cookies, candies, lollypops, chocolate and jelly before the child's first year of age. Hence, children should be discouraged from consuming excess sweets and added sugar.

Processed foods contain too much sodium and chronic sodium intake is associated with high blood pressure and mortality from cardiovascular diseases. Epidemiological studies offer consistent evidence that adult high blood pressure begins during childhood[27].

The familiarity and appreciation of sweets by children is reflected by the lower PWI observed in this study, corresponding to only 11%.

The supply of meats was appropriate in 76.2% of the days. On the other days, fat meats were offered. Fried foods were not offered, since the Department of School Food (DME) of the municipality of *São Paulo* recommends that this type of preparation should only be offered to children aged two years or more and at most, once every 15 days. A different reality is seen in Portuguese kindergartens: according to Lopes & Rocha[28], 21% of the monthly menus contain meals with some deep-fried component, and as many as 45.0% of the meals of some cafeterias contained deep-fried items. Concordantly, Erinosho *et al.*[6] studied 40 day care centers in New York during one day and found that 6.7% of the study institutions served French fries.

Foods containing *trans* fatty acids were present in all menus, but it must be reemphasized that no safe upper intake limit has been established. The World Health Organization[18] recommends that the maximum daily intake should not exceed 1% of the total energy intake. The present study prioritized the TACO[19] for assessing this criterion since the information contained in nutrition facts labels regarding this substance is unreliable. According to the *Regulamento Técnico de Porções de Alimentos Embalados Para Fins de Rotulagem Nutricional*[29], the content of a nutrient can be expressed as "zero" or "absent" if the food contains less than or equal the amounts deemed insignificant. Hence, if a serving of a food contains 0.2g or less of *trans* fatty acids, the manufacturer may omit it.

Regarding food waste, the mean PWI for day care centers varied from 25% to 43%, and for foods and preparations from 11% to 47%.

The foods that composed breakfast, namely milk, bread and cookies, were those with the highest PWI, namely 47%, 40% and 41%, respectively. These percentages may be justified by the fact that, according to the literature, most children have breakfast at home[30].

The plate waste associated with full meals (lunch and supper) was worrisome because only

60.0% of the food on the plate was consumed. While studying school meals in Portugal, Campos *et al.*[31] found a mean PWI of 31.0%, and a minimum PWI of 17.0%. On the other hand, Martins *et al.*[32] found that plate waste varied from 1.8 to 7.5% in public schools of *Piracicaba*, SP, Brazil.

Soups (vegetables, beans, chicken with vegetables, and pasta) were better accepted than full meals, with a PWI 34% lower than that of full meals. Analogously, Martins *et al.*[32] studied the acceptance of different preparations offered at school and found an acceptability of 90% for pasta soup. Although this is good from the waste viewpoint, the replacement of foods by soup should not be encouraged since soups have less flavor differentiation and taste stimulation, requires less chewing, and contains lower energy density[15].

The sensory characteristics of the menu may be influenced not only by the color monotony of these meals, but also by environmentally-related operational factors. According to the literature, food rejection increases when cafeterias are overcrowded and excessively noisy. In fact, it is known that an unpleasant eating environment affects eating behavior[33]. Moreover, food supply dynamics may reflect both the lack of motivation of the employees to improve meal acceptance and the difficulty of feeding young children during the meal period of the institution. It is noteworthy that each educator is responsible for the care and feeding of nine children[1].

Nahikian-Nelms[34] proposes important behaviors that educators should display during mealtime as a way to encourage eating and the formation of healthy eating habits, such as sitting at the table with the children, eating the same foods, not rushing the children, encouraging them to try the foods, not forcing them to eat, not using food as a prize, reward or punishment, having a pleasant conversation during the meal and creating opportunities for nutrition education during the meal.

Since the study group is under two years of age, assessing the factors that influence meal acceptance is difficult because during this period, children are beginning to learn the process of verbal communication, so food-related aversions, desires and sensations cannot be fully manifested[1]. This may explain the high level of plate waste observed in the present study.

It is noteworthy that plate waste is responsible for unnecessary costs and violates social, ethical and environmental issues. Furthermore, it reflects the poor quality of meals, highlighting possible failures in menu development, determination of serving sizes and definition of nutritional requirements.

Under the light of this premise, the importance of a dietician in the staff is highlighted, since dieticians learned to implement and supervise the periodical assessment of the plate waste-ingestion index and to analyze and identify the causes of food waste, performing regular reviews of serving sizes, developing projects of food and nutrition education, and promoting social, ecological and environmental awareness[9].

With respect to school food, dieticians should encourage educators to join forces, promote reflections and contribute to the acknowledgment of the school environment as a space for the development of food security, understood as the universal access to food in nutritionally appropriate quantity and quality to ensure health[35].

In this sense, to control means to analyze, compare and asses the procedures and performance of food services, aiming to reduce waste and optimize productivity once the production processes are known. The results are productivity gains, guaranteed quality service, less waste and inexpensive meals. To be effective and complete, waste-reduction programs must aggregate behavioral changes, education, and, especially, awareness of food handlers, thereby engaging in a war against hunger and for citizenship.

CONCLUSION

The present study found that the meals given to the children are low in vegetables, including leafy vegetables, and high in sweets, high-sulfur foods, fat meats and foods containing *trans* fatty acids. The meals are also monotonous in terms of colors.

Additionally, the PWI indicated high plate waste, since more than half of the food offered to the children was discarded. Hence, it is necessary to pay attention to the preparations and respective serving sizes, and to adopt new strategies for menu creation and planning, a critical step for controlling food waste.

COLLABORATORS

GL-SILVA helped to conceive, analyze and interpret the data, and write the article. MHA TOLONI helped to analyze and interpret the data. SSP RODRIGUES helped to analyze and interpret the data and in the critical review. AMCN ROCHA helped to analyze and interpret the data and in the critical review. JAAC TADDEI helped in the critical review and approval of the version to be published.

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Received on: 14/6/2012
Final version on: 30/10/2012
Approved on: 13/11/2012

Promotion of healthy eating at schools in the Federal District of Brazil[1]

Promoção da alimentação saudável: cenário das escolas da capital do Brasil

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ABSTRACT

Objective

The aim of the present study was to describe strategies for the Promotion of Healthy Eating at Public and Private Schools in the Federal District of Brazil.

Methods

A descriptive, analytical, cross-sectional study was carried out involving 122 Private Schools and 173 Public Schools. The components of health promotion in the school setting were adapted to the context of the promotion of healthy eating, with interviews conducted for the administration of a semi-structured questionnaire. The Student's *t* test, Spearman's correlation coefficients and likelihood ratios were used for the statistical analysis (5% level of significance; $p<0.05$).

Results

Only one private elementary school fulfilled the criteria for 20 of the 24 items studied. At the other extreme, two public high schools only fulfilled the criteria for three items. A positive correlation was found between number of meetings held with the school community to address healthy eating and presence of healthy environments as well as between presence of healthy environments and monitoring of nutritional status of schoolchildren ($p<0.01$). Schools that held an above-average number of meetings to address healthy eating had a smaller proportion of street vendors and local stores in the surrounding area ($p=0.01$). The majority of

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Apoio: Ministério da Saúde (convênio OPSAN/MS 5562/2004).

schools that had a partnership with healthcare professionals included the topic of healthy eating in the curriculum (p=0.04).

Conclusion

The different associations found demonstrate the importance and interdependence of the components of the promotion of healthy eating. Preschools have developed more strategies for the Promotion of Healthy Eating and health in general in comparison to other teaching modalities. Schools in the Federal District of Brazil need support and training to be developed as a "Health Promoting School", specifically with regard to actions directed toward healthy eating.

Indexing terms: Health promotion. School feeding. Schools.

RESUMO

Objetivo

Caracterizar as estratégias de Promoção da Alimentação Saudável em escolas públicas e privadas do Distrito Federal.

Métodos

Estudo transversal descritivo-analítico realizado com 122 escolas particulares e 173 públicas. Adaptaram-se os componentes de promoção da saúde no ambiente escolar para o contexto da Promoção da Alimentação Saudável, sendo realizadas entrevistas para a aplicação do instrumento. Os testes utilizados foram: t de Student, coeficiente de correlação de Spearman e teste da razão de verossimilhança (nível de significância p<0,05).

Resultados

Apenas uma escola privada de ensino infantil contemplava positivamente 20 dos 24 itens pesquisados. No outro extremo, duas escolas públicas de ensino médio contemplavam apenas três itens. Observou-se correlação positiva entre o número de reuniões com a comunidade escolar para abordar a temática alimentação saudável e a presença de ambientes saudáveis e; entre a presença de ambientes saudáveis e o monitoramento do estado nutricional dos escolares (p<0,01). As escolas que realizavam reuniões acima da média para abordar alimentação saudável possuíam em menor proporção ambulantes e/ou comércios locais próximos (p=0,01). A maioria das escolas que possuíam parceria com profissional de saúde incluía a temática Alimentação Saudável no currículo (p=0,04).

Conclusão

As diversas associações encontradas demonstram a importância e a interdependência dos componentes de Promoção da Alimentação Saudável estudados. As escolas de educação infantil desenvolveram mais estratégias de Promoção da Alimentação Saudável e da saúde em relação às demais modalidades. A maioria das escolas do Distrito Federal precisa de apoio e capacitação para desenvolver-se como Escola Promotora da Saúde, no recorte específico de ações voltadas para a alimentação saudável.

Termos de indexação: *Promoção da saúde. Alimentação escolar. Instituições acadêmicas.*

INTRODUCTION

International conferences on health promotion feature schools as the ideal setting for the development of actions aimed at encouraging healthy habits and lifestyles[1]. In the 1980s, the Health Promoting School initiative was established by the Pan American Health Organization (PAHO) and World Health Organization (WHO), consisting of an integral endeavor involving education, health and society. This action can be evaluated based on three interrelated components: 1) integral health education, 2) the creation and maintenance of healthy physical and psychosocial environments and 3) the offer of healthcare services, healthy eating and active living[2-4]. Experiences based on this proposal have been solidified in Brazil, as demonstrated by the development of actions that enable broadening the role of school meals in the promotion of health and nutrition education[5].

The promotion of healthy eating at school is based on an integral, multidisciplinary view that considers the school in its familial, community and social context[6,7]. The aim is to generate knowledge as well as develop skills and healthy attitudes by conducting educational opportunities in a critical, reflective fashion[8]. However, the relationship between knowledge and the adoption of healthy eating practices is complex and it is necessary for schools to be transformed into appropriate environments for the development of skills that can lead to healthy attitudes[9]. Moreover, schools cannot stand alone on this path and articulation with other sectors is essential to the success of such actions[5].

The project entitled "Schools Promoting Healthy Eating Habits" was created in 2001 in the city of *Brasília*, capital of Brazil. This project promotes healthy eating habits at public and private preschools and elementary schools in the Federal District. The project initially carried out play activities with students and delivered teaching material to schools, which was followed by actions for the training of educators and the heads of cafeterias[10-12]. In 2006, the project was restructured to include other actors in the school community (cooks, principals, coordinators, parents and members of the School Meal Council). Considering the recommendations of the PAHO/WHO for Health Promoting Schools, the project adopted the three components described for healthy eating strategies at basic education schools in the Federal District of Brazil.

The aim of this paper is to systematize this information, characterize healthy eating strategies at schools and contribute toward the effective planning of actions directed at the healthy eating and health promotion in the school setting.

METHODS

A descriptive, analytical, cross-sectional study was carried out between April 2008 and June 2009, involving Public and Private Schools. In 2006, the Federal District of Brazil had 589,969 students enrolled in 1061 public and private schools distributed among 30 administrative regions[13] (territorial areas the physical limits of which define the jurisdiction of governmental actions for the purposes of the administrative decentralization and the coordination of public services)[14].

For the sample calculation, the sampling procedure was stratified into public and private schools to ensure homogeneity with regard to the type of school. Simple, random sampling was then performed within each stratum for the selection of schools. Schools without updated registry data were excluded due to the impossibility of contacting possible participants. Thus, a universe of 607 Public Schools and 402 private schools was used, among which 287 schools were selected. Ninety-four additional schools were added to compensate for possible losses, totaling a sample of 381 schools.

The respondents were principals, coordinators and teaching advisers of the schools. In cases of refusal to participate, the school was replaced with another from a list planned for this purpose, with care taken for the replacement to be within the same stratum as the school it was replacing.

A semi-structured questionnaire was used for data acquisition and was composed of 48 open-ended and closed-ended questions divided into four datasets: 1) identification and characterization of the school; 2) participation of the school community in school activities; 3) presence of healthy environments; and 4) partnership with the health sector and monitoring of nutritional status. Datasets 2, 3 and 4 were based on the three components the PAHO recommends as the goals of schools considered to be "health promoting", adapted to the context of the promotion of healthy eating[2,15-18]. The variables were organized to address these components of interest (Chart 1). The participation of the school community was determined based on the number of meetings held with the community to address the issue of healthy eating and general topics, the collective,

participatory drafting of the Teaching Policy Project and the inclusion of the issues of health and healthy eating in the school curriculum, totaling 10 variables. The presence of healthy environments included the existence and use of school spaces for the promotion of healthy eating (dining hall, site to post information, room for cooking classes, vegetable garden, commercial cafeteria and street vendors), totaling nine variables. The investigation of partnerships with the health sector (healthcare professionals, hospitals/health units and non-governmental organizations) and nutritional monitoring involved five variables (Chart 1).

A pilot test was carried out at four schools in the Federal District (two public and two private). Following telephone contact for scheduling, interviews were held for the administration of the questionnaire.

Descriptive and inferential analyses of the exploratory variables were performed based on the calculation of proportions with 95% confidence intervals. The Student's *t* test was used for the comparison of means of meetings with the school community. Either Pearson's correlation coefficient or the Likelihood Ratio Test (depending on whether the variable was continuous or categorical) was used for the determination of differences between types of school (public *vs.* private or by teaching modality) regarding the number of positive items for the promotion of healthy eating. The Likelihood test is an alternative to Pearson's Chi-square test for associations between nominal variables. This test exhibits Chi-

Chart 1. Description of items evaluated for the development of participation of school community, healthy environments and partnership with health sector (including monitoring of nutritional status). *Brasília* (DF), Brazil, 2008-2009.

Components		Items evaluated
Participation of school community	Meetings	1) Mean number of meetings with parents to address general topics. 2) Mean number of meetings with parents to address healthy eating. 3) Mean number of meetings with employees to address general topics. 4) Mean number of meetings with employees to address healthy eating.
	Drafting of Teaching Policy Project	5) Suggestions from meetings considered in drafting of Teaching Policy Project. 6) Involvement of school community in drafting of Teaching Policy Project. 7) Involvement of teachers, coordinators and principals in drafting of Teaching Policy. Project. 8) Mean number of teachers involved in drafting of Teaching Policy Project.
	School curriculum	9) Inclusion of healthy eating issue in school curriculum. 10) Inclusion of health issues in school curriculum.
Presence of healthy environments		1) Dining hall with capacity to meet demand of students during meals. 2) Specific site for publicizing information on health and healthy eating. 3) Involvement of students in establishment of these specific sites. 4) Permanent destination of these specific sites by the school. 5) Place for cooking classes. 6) School garden for promotion of healthy eating. 7) Commercial cafeteria that promotes healthy eating. 8) School cafeteria that produces meals provided by Secretary of Education and promotes healthy eating. 9) Absence of street vendors and local stores near school.
Partnership with health sector and monitoring of nutritional status		1) Monitoring of weight and height of students. 2) Monitoring performed with all students. 3) Partnership/voluntary participation with healthcare professional. 4) Partnership with health unit or hospital. 5) Partnership with other institutions that promote health and/or healthy eating.

squared distribution and is based on estimates by maximum likelihood. The non-parametric Gamma test was used to indicate the direction of the association between the components of healthy eating.

Teaching modality was categorized as Preschool, Elementary School and High School. As a given school could offer more than one teaching modality, the interpretation of the analyses was performed within each specific group, considering only the presence or absence of the modality. Thus, no summing of the crude numbers of each modality was performed. To evaluate constant items in each component, items related to cooks and the cafeteria that produces the school meals provided by the Secretary of Education were excluded, as such items only related to public schools. Moreover, frequencies higher than the means found in the sample were used to consider items regarding meetings with the school community and the mean number of teachers participating in the Teaching Policy Project as positive. The level of significance was set to 5% ($p<0.05$) in all analyses.

This study received approval from the Human Research Ethics Committee of the School of Health Sciences of the *Universidade de Brasília* under protocol number 006/2005. All participants signed a Statement of Informed Consent.

RESULTS

One hundred twenty-two private schools and 173 public schools participated in the study (total: 295 schools). Among the interviewees, 54% (n=151) were coordinators, 22% (n=63) were principals, 9% (n=25) were vice-principals and 15% (n=42) were categorized as "others". Schools with preschool classes (59%; n=172) and elementary school classes (55%; n=162) had greater participation in the study.

At Public Schools, the mean number of students and teachers was 592±312 and 58±11, respectively. At Private Schools, the mean number of students and teachers was 319±267 and 19±16, respectively.

Component: Presence of healthy environments at school

Only five schools fulfilled all the items analyzed regarding this component, considering the specificities of the Public and Private Schools. Among these five schools, four offered the preschool modality, four offered the elementary school modality and all five offered the high school modality (Figure 1). Four of these schools were private. The mean number of items met for this component was three among the public schools and five among the Private Schools (Figure 2). Schools offering preschool or high school modalities had a greater number of positive items for the promotion of healthy eating in this component ($p<0.001$).

The majority of schools (72%; n=211) did not have a dining hall large enough to meet the demands of students during meals. This environment was more prevalent in Private Schools (60%; n=53; $p<0.001$) and those offering the preschool modality ($p<0.001$).

A total of 66% (n=194) of the schools had specific sites to publicize information on health and healthy eating. The prevalence of such sites was significantly greater in Public Schools ($p=0.003$). However, a significant association with the permanent use of this educational space was found at Private Schools ($p=0.03$). Most high schools had permanent sites to publicize information on health and healthy eating ($p=0.001$). The vast majority of schools (86%; n=166) allowed students to participate in the assembly of these sites, especially schools offering the preschool modality ($p=0.005$).

The presence of a commercial cafeteria was found in 46% (n=136) of the schools, with a significantly greater prevalence in public schools ($p=0.04$). Commercial cafeterias were more concentrated in schools offering the elementary school modality (n=120). The cafeteria was used

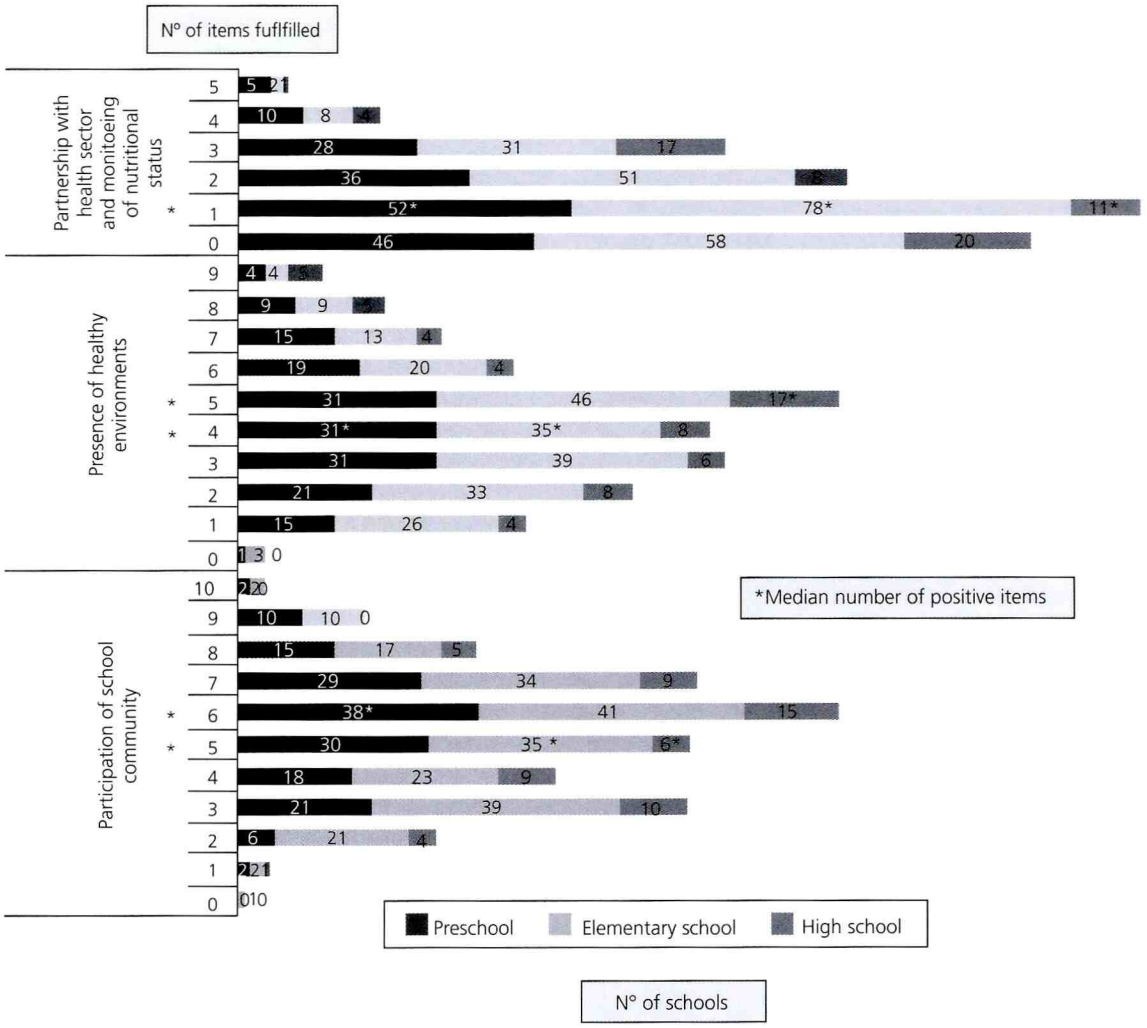

Figure 1. Characterization of schools according to fulfillment of items for the development of participation of school community, healthy environments and partnership with health sector (including monitoring of nutritional status) by teaching modality. *Brasília* (DF), Brazil, 2008-2009.

as a place for the promotion of healthy eating in 59% (n=80) of the schools that had cafeterias. This type of use was significantly more prevalent in Private Schools ($p<0.001$) and schools offering the preschool modality ($p=0.003$). The presence of a school cafeteria that produces meals provided by the Secretary of Education was found in 82% (n=142) of the Public Schools. Schools with a commercial cafeteria and a school cafeteria for the production of meals provided by the government accounted for 41% of the Public Schools (n=70).

The presence of street vendors and local stores near the school (within 50 meters of the entrance) was found in 41% (n=121) of the schools. A greater concentration was found near public schools ($p=0.01$) and those offering the elementary school modality (n=105). Most of the schools offering the preschool modality did not have street vendors or local stores in the immediate surroundings (n=115).

The majority of schools (61%; n=180) had no place for cooking classes. Among the schools with a place for such activities, a greater number were Private Schools (60%; n=67; $p<0.001$) and those that offered the preschool modality ($p=0.005$). The cafeteria (whether commercial or for the production of meals provided by the

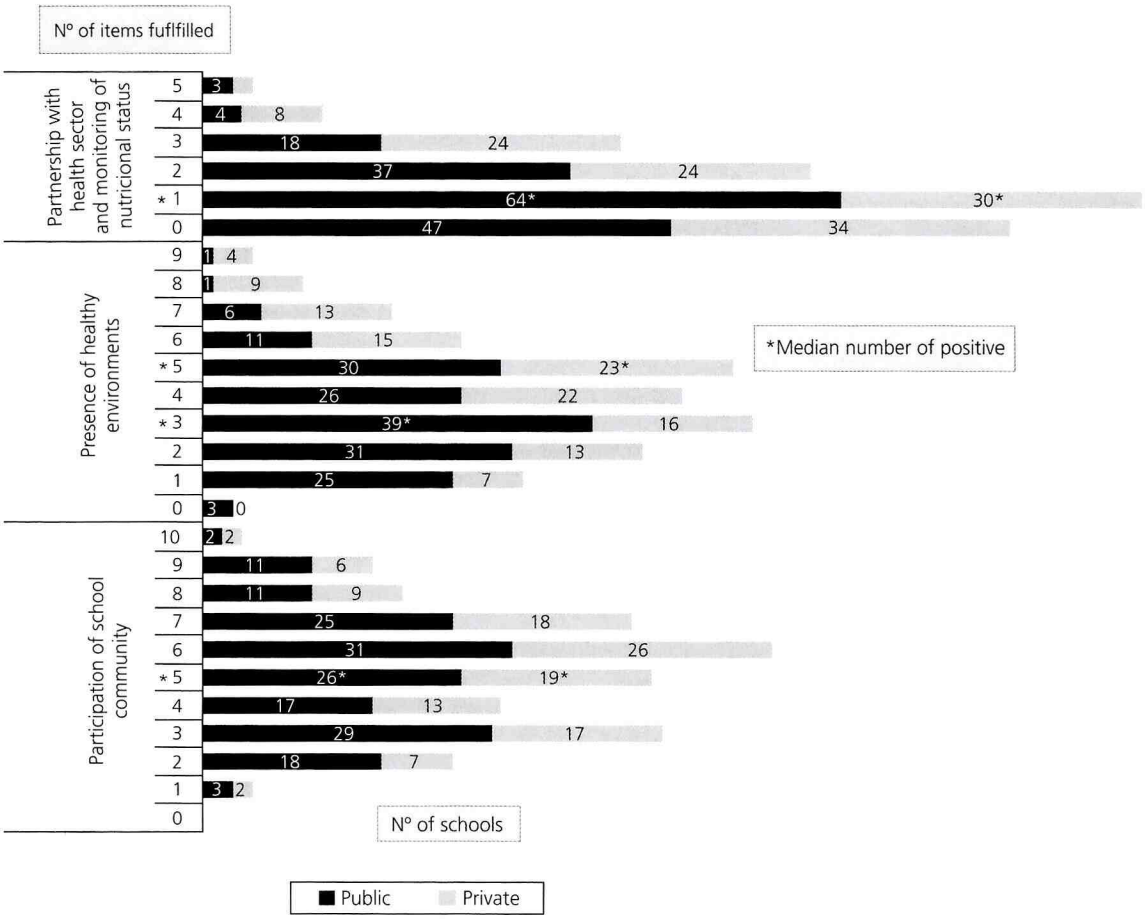

Figure 2. Characterization of schools according to fulfillment of items for the development of participation of school community, healthy environments and partnership with health sector (including monitoring of nutritional status) by type of school. *Brasília* (DF), Brazil, 2008-2009.

government) was used in 23% (n=26) of the schools that had no other place for cooking classes. A vegetable garden was found in 34% (n=100) of the schools and used for the promotion of healthy eating in 86% of cases. The majority of schools with a vegetable garden offered the preschool modality (72%).

Component: Participation of school community

Only two preschools and two elementary schools fulfilled all ten variables related to this component (Figure 1). The median number of positive items was six in preschools and five in elementary schools. Public and private schools had a median of five positive items in this component (Figure 2). Schools offering the preschool modality had the highest number of positive items (p=0.002).

At Public Schools, the mean number of meetings held per year to discuss the issue of healthy eating with parents and employees was one for each group. At Private Schools, these figures were 2.4 meetings/year with parents (p=0.016) and 3.6 with employees (p=0.004).

The suggestions raised during meetings with members of the school community were considered in the drafting of the Teaching Policy Project in 59% (n=175) of the schools, among which 57% (n=99) were Public Schools. Parents

and employees were participants in the drafting of the project in 57% (n=169) of the schools. Teachers, coordinators and principals were participants in 92% (n=270) of the schools. Overall, these social actors had greater participation in the drafting of the project in public schools (60%; n=162).

A statistically significant difference was found in the mean number of meetings with parents on the issue of healthy eating between schools that included parents' suggestions in the drafting of the project and those that did not consider such suggestions ($p<0.001$). The mean number of meetings per year was 2.5 in the former group and nearly zero (0.3) in the latter group.

Nine percent (n=28) of the schools addressed all variables related to the drafting of the Teaching Policy Project. Eighteen of these schools were public schools, 18 offered the preschool modality and 24 offered the elementary school modality. The median number of positive items for the preschool and elementary school modalities was three. Regarding the type of school, the median number of positive items was three for public schools and two for private schools.

Ninety percent (n=266) and 78% (n=230) of the schools included activities related to health and healthy eating in the curriculum, respectively, with greater frequencies found in the public schools in comparison to private schools ($p=0.001$). Moreover, these topics were more prevalent in schools that offered the preschool modality ($p<0.001$).

Component: Partnership with health sector and monitoring of nutritional status of schoolchildren

Only three public schools and two private schools fulfilled all items related to this component (Figure 2). These schools reported having partnerships with healthcare professionals, health units/hospitals and other institutions that promote health/healthy eating and performed nutritional monitoring. Twenty-seven percent 27% (n=81) of the schools did not perform any monitoring of the nutritional status of the students and had no partnerships with the health sector. The median number of positive items in the component was one for all teaching modalities (Figure 1) and both types of schools (Figure 2), indicating that the schools either had a partnership or performed nutritional monitoring.

Weight and height monitoring of the students was performed in 35% (n=103) of the schools, among which 62% (n=64) performed anthropometric evaluations on all students. The prevalence of anthropometric evaluations of all students was higher in private schools ($p=0.01$). Moreover, this monitoring was more prevalent in schools offering the preschool modality (63%; n=45). Forty-six percent (n=47) of the schools performed monitoring every semester and 31% (n=32) performed monitoring on an annual basis.

Partnerships with healthcare professionals were found in 40% (n=118) of the schools, with higher prevalence rates in public schools ($p=0.04$) and those that offered the preschool modality ($p=0.01$). The most commonly found health professional was a dentist (57%; n=67), followed by a nutritionist (45%; n=53). Partnerships with physicians were significantly more prevalent in public schools ($p=0.017$) and partnerships with nutritionists were significantly more prevalent in private schools ($p<0.001$). A significant association was found between the monitoring of the nutritional status of all students and partnerships with a nutritionist ($p=0.004$) and/or health unit/hospital ($p=0.017$). Besides this partnership, 34% (n=100) of the schools relied on the support of health units or hospitals, with a greater frequency among public schools ($p=0.001$).

Joint evaluation of all three components

None of the schools adequately fulfilled all 24 variables investigated as positive to the promotion of healthy eating. Only one private

preschool fulfilled 20 items, which was the maximum number in the present study. At the other extreme, two public schools only fulfilled three items. Table 1 displays the mean number of items fulfilled for the three components. The analysis of the different teaching modalities revealed that schools offering the preschool modality had the greatest number of items evaluated as positive (r=0.334; p<0.001).

Different associations were analyzed among the three components. Schools that included healthy eating in the curriculum held a greater number of meetings with parents (mean of 0.38 meetings among schools that included healthy eating in the curriculum versus 0.04 among those that did not include this subject; p=0.001) and employees (mean of 0.24 meetings among schools that included healthy eating in the curriculum versus 0.06 among those that did not include this subject; p=0.005). This association demonstrates that the increase in the number of items promoting healthy eating in one group (inclusion of the issue in the curriculum) was accompanied by an increase in the other group (meetings with the school community) (r=0.330; p<0.001). A positive correlation was also found between the number of meetings with the school community to address the issue of healthy eating and the presence of healthy environments (r=0.249; p<0.001). Schools that held an above-average number of meetings with the community to address healthy eating also had fewer street vendors and/or local stores in the proximities of the school (r=0.282; p=0.001). The vast majority of schools that had partnerships with healthcare professionals included the issue of healthy eating in the curriculum (p=0.04). Moreover, a positive correlation was found between the presence of healthy environments and the monitoring of the nutritional status of the students (r=0.230; p<0.01).

Table 1. Characterization of schools according to fulfillment of items for the development of participation of school community, healthy environments and partnership with health sector (including monitoring of nutritional status) by teaching modality and type of school. *Brasília* (DF), Brazil, 2008-2009.

Component	Number of positive items	Teaching modality						Type of school			
		Preschool		Elementary school		High school		Public		Private	
		N	%	N	%	N	%	N	%	N	%
	3	0	0	0	0	1	1.7	2	1.2	0	0
	4	1	0.6	2	1	3	5.1	3	1.7	2	1.7
	5	3	1.7	15	6.6	2	3.4	13	7.6	3	2.6
Participation of	6	9	5.2	15	6.6	3	5.1	13	7.6	6	5.2
school community	7	8	4.7	20	8.8	2	3.4	15	8.7	6	5.2
	8	9	5.2	17	7.5	2	3.4	18	10.5	4	3.4
+	9	23	13.4	28	12.4	4	6.8	24	14.0	11	9.5
	10	23	13.4	25	11.1	4	6.8	19	11.0	16	14.0
Healthy environments	11	16	9.3	24	10.6	9	15.3	18	10.5	11	9.5
	12	15	8.7	15	6.6	5	8.5	10	5.8	8	7.0
+	13	16	9.3	13	5.8	3	5.1	9	5.2	11	9.5
	14	10	5.8	17	7.5	7	12.0	10	5.8	8	7.0
Partnership with	15	10	5.8	12	5.3	3	5.1	10	5.8	6	5.2
health sector and	16	9	5.2	6	2.7	3	5.1	2	1.2	9	7.8
monitoring of	17	12	7	10	4.4	4	6.8	5	3.0	8	7.0
nutritional status	18	4	2.3	4	1.8	2	3.4	1	0.6	3	2.6
	19	3	1.7	3	1.3	2	3.4	0	0	3	2.6
	20	1	0.6	0	0	0	0	0	0	1	1.0
	Total number of schools	172	100	226	100	59	100	172	100	116	100
	Median number of positive items	11	-	10	-	11	-	9	-	11	-

DISCUSSION

The present findings reveal heterogeneity among schools regarding the components of the promotion of healthy eating, making it necessary to considered specificities in the planning and development of strategies for promoting healthy eating in the school setting. Some of the actions necessary for these schools are found stipulated in Directive 1010[19], issued in 2006 by the Brazilian Ministries of Education and Health and recognized as a first step in the establishment of guidelines for the promotion of school health on the national level. Despite this directive, the schools studied in the Federal District need support for their development as a Health Promoting School, which justifies national and international governmental efforts directed toward the development of financial and educational mechanisms as well as additional support to potentiate the establishment of Health Promoting Schools[20,21].

To strengthen health promoting actions in Brazilian schools, the effective institutionalization of the "Health at School Program"[20] created in 2007 is needed through the formulation of health policies with and for the educational community as well as the participation of key social actors in the management of the program, the strengthening of technical capacities, research and the mobilization of resources.

The school profile with the greatest number of variables considered significant for the promotion of healthy eating was the private school and the preschool teaching modality. The importance of initiating health promotion actions in the early years of life is unquestionable. However, children aged five years or older are habitually excluded from priority strategies of official health and education policies, despite being biologically, nutritionally and socially susceptible to health problems[22,23].

Sichieri & Souza[24] performed a review on obesity prevention in children and adolescents and found that interventions were more effective in elementary and high schools. The positive results with adolescents may be explained by the fact that individuals in this age group are more capable of assimilating the intervention material and administrate their choices better.

According to Inter-Ministerial Directive 1010/2006, schools should develop family information strategies, emphasizing co-responsibility in the promotion of healthy eating[19]. Moreover, the participation of the school community in actions developed at schools is one of the requirements for the classification of a Health Promoting School[2]. While the majority of schools analyzed in the Federal District reported holding meetings with parents to address this issue, the mean number of meetings was very low[8]. Despite the few meetings, the associations found between the components and the number of meetings evidence the importance of this action for the acquisition or modification of other items. Moreover, there is evidence that the consistent participation of parents in the school process favor the self-confidence and satisfaction of parents with the school and helps enhance the motivation, attitudes and behavior of the students in the classroom[25]. Benefits have also been reported regarding the health and wellbeing of students, such as an increase in physical activity, improved eating patterns and enhanced knowledge on the prevention of diabetes and obesity[26,27].

Regarding the drafting of the Teaching Policy Project, Public Schools carried out this process in a collective, participatory fashion. Federal programs underway since 2004 develop actions to strengthen school councils throughout the country. When aggregated to the Teaching Policy Project, the aim of such actions is to contribute toward more democratic, civic-minded schools. This subject merits investigation in light of the importance of the drafting of the Teaching Policy Project with regard to the inclusion and discussion of the issues of health and healthy eating[28].

The majority of schools reported including the issues of health and healthy eating in the curriculum, but it is not known whether the

inclusion of these issues occurs in a continual, cross-sectional, interdisciplinary fashion, as established in the National Curriculum Parameters[29]. An important aspect related to the Teaching Policy Project and curricular actions regards the difficulty educators have in placing what is proposed in the project into daily practice. Therefore, it is necessary to invest in health education for the social actors of the school community in order to strengthen the active exercise of actions aimed at the promotion of healthy eating.

Due to the methodological design of the present study, the origin of the positive association between the inclusion of the healthy eating issue and the existence of meetings with parents and employees to address this issue is not known. However, the results indicate the concern of the school community with the issue of healthy eating, as epidemiological data on excess weight and chronic diseases has increased among Brazilian schoolchildren[30].

Regarding the creation and use of healthy environments, information offered in the classroom should be complemented with activities that occur outside the classroom, such as dining halls, which are recognized for their importance in health promotion strategies directed at schoolchildren[19]. Few schools in the Federal District have all environments considered to promote healthy eating. Moreover, the participation of the school community proved to have a protective effect for the presence of healthy environments and the absence of unhealthy environments.

In two years of the Efficient School Meal Manager Prize, the number of candidate municipal governments with schools containing a dining hall reached more than 80%. A dining hall for school meals is more than merely a place to eat; it is also a place for socialization among students and teachers and the promotion of healthy eating practices[31]. The manner by which school meals are addressed is related to the guaranty of basic human rights. The existence of school meals implicitly transmits to students the notion that all have the right to a nutritionally adequate diet and to make meal time a socio-cultural act of companionship and pleasure.

The establishment of a school vegetable garden is another important initiative for the promotion of healthy eating. Among candidate schools for the aforementioned prize, vegetable gardens were found in 2,145 schools (25% of the total) in 2004 and 1,560 schools (30% of the total) in 2005[31]. The present study found a similar percentage of vegetable gardens used for the promotion of healthy eating. However, it should be stressed that the existence of a vegetable garden *per se* does not necessarily signify its use for the promotion of healthy eating. Communication with the school community is needed for the development of teaching activities and caring for the garden.

Projects that allow children to handle foods and try new flavors and textures can contribute toward adequate eating choices. This is an important issue for the school community to consider, especially at public schools, as less than half of the schools analyzed had a place for cooking classes. With the increase in the consumption of processed foods in the Brazilian population, it is common to find children and adolescents who are unaware of certain types of food, especially fruits and vegetables. Thus, actions that allow direct contact with these foods can assist in the promotion of healthy eating in the school setting.

Sites for the posting of information on health and healthy eating were found in a large portion of the schools. When used in combination with other health promoting actions, this simple strategy can be used to foster the involvement of the school community, allowing access to healthy practices and socio-cultural aspects of dietary habits.

The prevalent presence of a commercial cafeteria at public elementary schools is a particular concern. Besides existing alongside the cafeteria that provides free meals from the

Brazilian National School Meal Program, its use for the promotion of healthy eating was cited little. According to Sturion *et al.*[32], the presence of commercial cafeterias is inversely associated with daily adherence to the national meal program. The authors also report the considerable presence of street vendors and local stores near public elementary schools. A number of regional laws regulating sales in commercial cafeterias have been issued in Brazil[33]. Specifically in the Federal District, District Law nº 3,695 addressing the promotion of healthy eating in Public and Private Schools went into effect in 2006[34], but was revoked in March of the same year. The findings of the present study and previously cited epidemiological data indicate the need for policies that involve the owners of commercial cafeterias.

The component *partnership with the health sector and monitoring of nutritional status* was addressed little at the schools. The study design does not allow determining whether this partnership is structured as a public health program, in which the objectives are not limited to the immediate care of health problems among the students, but seek to ensure the rights of children and adolescents to benefit from actions organized in the collective realm. A positive association was found between the monitoring of nutritional status and the presence of healthy environments. Proper nutritional diagnoses are important to outlining the needs of the population at each school[20], allowing a precise determination of the magnitude, behavior and determinants of nutritional problems as well as the identification of groups at risk and adequate interventions[17,26]. In the present study, public schools that offer the preschool modality prioritize the monitoring of weight and height among preschoolers. However, other age groups also require such monitoring. The Brazilian National School Health Survey reports prevalence rates of 18% and 5% for overweight and obesity among ninth grade students[30].

The positive association between partnerships with healthcare professionals and the inclusion of the issue of healthy eating in the curriculum suggests an exchange of knowledge that can potentiate classroom activities. For such, it is necessary for educators to undergo training in health education. Actions with this purpose should include ongoing nutritional education to allow knowledge building and the determination of local needs. Such training could also allow educators to establish dynamic classroom activities with their students.

FINAL CONSIDERATIONS

The different associations found in the present study demonstrate the importance and interdependence of the different components for the promotion of healthy eating. However, this field of knowledge needs to be explored through further in-depth studies for a better understanding of the issues involved.

Preschools were found to develop more strategies for the promotion of health and healthy eating. However, it is essential to encourage these initiatives in other teaching modalities, as epidemiological data demonstrate that adolescents increasingly exhibit unhealthy living habits. Reflections on this issue should be carried out by all social actors involved, such as members of the school community and administrators in charge of the establishment of policies and strategies aimed at encouraging healthier lifestyles. The majority of schools in the Federal District of Brazil require support and training in order to become Health-Promoting Schools with regard to the encouragement of healthy eating.

CONTRIBUTORS

JRM SILVA contributed to conception and development of study, data analysis and drafting of manuscript. BAS SCHMITZ and MLCF RODRIGUES contributed to conception and development of study, data analysis, drafting of manuscript and revision of final version. CG Gabriel contributed to drafting of manuscript and revision of final version; author responsible for negotiations.

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Received on: 24/2/2012
Final version on: 11/10/2012
Approved on: 12/11/2012

Variance sources and ratios to estimate energy and nutrient intakes in a sample of adolescents from public schools, *Natal*, Brazil[1]

Fontes e razões de variância para estimar a ingestão de energia e nutrientes de uma amostra de adolescentes de escolas públicas

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ABSTRACT

Objective

The aim of this study was to describe the sources of dietary variance, and determine the variance ratios and the number of days needed for estimating the habitual diet of adolescents.

Methods

Two 24 hour food recalls were used for estimating the energy, macronutrient, fatty acid, fiber and cholesterol intakes of 366 adolescents attending Public Schools in *Natal, Rio Grande do Norte*, Brazil. The variance ratio between the intrapersonal and interpersonal variances, determined by Analysis of Variance, was calculated. The number of days needed for estimating the habitual intake of each nutrient was given by the hypothetical correlation (r)≥0.9 between the actual and observed nutrient intakes.

[1] Article elaborated from the thesis of SCVC LIMA, entitled: "Nutritional anthropometric status, lipid profile and food consumption as risk factors for cardiovascular disease in adolescents". Universidade Federal do Rio Grande do Norte; 2011.

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Results

Sources of interpersonal variation were higher for all nutrients and in both genders. Variance ratios were <1 for all nutrients and higher in women. Two 24 hour dietary recalls were enough to assess energy, carbohydrate, fiber and saturated and monounsaturated fatty acid intakes accurately. However, the accurate assessment of protein, lipid, polyunsaturated fatty acid and cholesterol intakes required three 24 hour recalls.

Conclusion

Interpersonal dietary variance in adolescents was greater than intrapersonal variance for all nutrients, resulting in a variance ratio of less than 1. Two to three 24 hour recalls, depending on gender and the study nutrient, are necessary for estimating the habitual diet of this population.

Indexing terms: Adolescent. Energy intake. Food consumption. Nutrients.

RESUMO

Objetivo

O objetivo deste estudo foi descrever as fontes de variância da dieta, determinar as razões de variâncias e o número de dias necessários para estimar a dieta habitual em adolescentes.

Métodos

A ingestão de energia, macronutrientes, ácidos graxos, fibra e colesterol foram estimadas por meio de dois recordatórios de 24 horas, aplicados em 366 adolescentes de escolas públicas de Natal, Rio Grande do Norte. A razão de variância foi calculada entre o componente da variância intrapessoal e interpessoal, determinada pela Análise de Variância. A definição do número de dias para a estimativa da ingestão habitual de cada nutriente foi obtida considerando a correlação hipotética de (r)≥0,9, entre a verdadeira ingestão de nutrientes e a observada.

Resultados

As fontes de variância interpessoal foram maiores para todos os nutrientes e em ambos os sexos. As razões de variâncias foram <1 para todos os nutrientes, e mais elevadas no sexo feminino. Dois dias de recordatórios de 24 horas seriam suficientes para avaliar com precisão o consumo de energia, carboidratos, fibra, ácidos graxos saturados e monoinsaturados, exceto para proteínas, lipídeos, ácidos graxos poliinsaturados e o colesterol, que necessitariam de três dias.

Conclusão

A variância interpessoal da dieta dos adolescentes foi maior do que a intrapessoal, para todos os nutrientes, repercutindo em uma razão de variância menor que 1. Para estimar a dieta habitual nesta população, uma variação de dois a três dias é necessária considerando o sexo e o nutriente avaliado.

Termos de indexação: *Adolescente. Ingestão de energia. Consumo de alimentos. Nutrientes.*

INTRODUCTION

Data on food consumption and habitual diet are important in epidemiological studies not only because they allow estimating the energy and nutrient intakes of a population, but also because they demonstrate whether the consumed foods are associated with disease-related outcomes. Assessing habitual food intake is complex because it involves factors related to daily intake variability, information reliability and identification of under- or overreporting[1-3].

Food intake and variance estimates differ among populations, genders, age groups and cultures[4]. The number of 24 hour food Recalls (24hR) necessary for assessing habitual energy and nutrient intakes accurately remains controversial[5-8].

At least two nonconsecutive observation days has generally been suggested. Observation days must be planned considering seasons of the year and different days of the week. With these criteria, it is possible to estimate which intra- and interpersonal variations should be used for defining the number of consumption measures.

These measures of variance can therefore be used to conduct studies in similar populations[5,6]. Variance ratios can also be used in population studies where food intake was measured for a single day. In this case, statistical adjustments are recommended to eliminate the effect of intrapersonal variance[9].

Observed nutrient intakes vary significantly depending on age group[10,11], gender[12] and culture, as seen in Russian and American adolescents[7]. Adult period-to-period and day-to-day interpersonal variations contribute significantly to energy and macronutrient intake variations[2]. Brazilian studies that assess the number of 24hR needed for estimating the habitual intake of adolescents are scarce and have been done only in the country's southeast, in the cities of *Piracicaba* (*São Paulo*)[13] and *São Paulo* (*São Paulo*)[14]. The present study is different because it was done in the Northeast region where the sociocultural and socioeconomic indicators are differences. The aim of this investigation was to describe sources of data variance, and to calculate variance ratios and the number of days needed for estimating the habitual dietary intake of adolescents from the city of *Natal, Rio Grande do Norte*, Brazil.

METHODS

A cross-sectional study was conducted with 432 adolescents aged 10 to 19 years, attending municipal schools between April 2007 and November 2008, in *Natal*, Northeast Brazil. The investigation was approved by the Research Ethics Committee of the *Universidade Federal do Rio Grande do Norte* (URFN), under protocol n° 112/06. All participants provided written Informed Consent prior their inclusion in the study.

Study design, calculation of sample size, sampling and field logistics for data collection have been described elsewhere[15]. A pilot study was done to estimate the prevalence of dyslipidemia and determine sample size. The statistical parameters included an estimated limit of error of 4% and a sample loss of 30%.

The sample size (483) was defined by stratified sampling with Neyman allocation as follows: n_{North}=285 n_{South}=63 n_{East}=34 n_{West}=101, and the number of schools (21) was given by the mean number of students per school by proportional allocation: n_{North}=9 n_{South}=3 n_{East}=3 n_{West}=6.

Food intake

Each participant answered two specific 24 hour dietary recalls[16] at an interval of 30 to 45 days, according to the following criteria: (1) on different days excluding Mondays to avoid recording atypical data; (2) at different times of the month, considering the purchasing power of the families; and (3) at different times of the year due to seasonal foods.

Food intake data were collected by a team trained as recommended by Thompson & Byers[17]. Interviews were done at the schools.

Food intakes were recorded in cooking units aided by photographs of common foods and two manuals created by the researchers, namely the Household Utensil Measures Manual and the Food Portions Manual.

Despite the limitations associated with administering the 24hR to 10-year-olds, the information collected by each 24hR was double checked to assess interview quality and standardize food portions and recipes. Cooking units and food units were converted to grams, as recommended by the literature[18,19]. Regional and other unusual preparations were made at the Food Technique Laboratory, Department of Nutrition, UFRN.

The energy, macronutrient, Monounsaturated Fatty Acid (MUFA), Polyunsaturated Fatty Acid (PUFA), Saturated Fatty Acid (SFA), fiber and cholesterol contents of the diets were determined by the software Virtual Nutri 2.0 plus[20]. Databanks of food preparations were updated with the inclusion of preparations and the nutritional composition of certain foods. The Food

Composition Table[21] and United States Department of Agriculture (USDA)[22] databases were selected because of their more comprehensive and updated nutrition information, including that of regional foods. Nutrition information taken from processed food labels was also used. Participants with an energy intake greater than 5,000kcal or smaller than 500kcal were excluded[4].

Data analysis

The study databank included the energy, carbohydrate, protein, lipid, MUFA, PUFA, SFA, fiber and cholesterol intake information stored in the Virtual Nutri 2.0 plus software[20]. The software Statistical Package for the Social Sciences (SPSS) 17.0 was used for the statistical analyses. Descriptive analysis (mean and standard deviation) and the skewness-kurtosis test for normality were also used.

Variance components were given by one-way Analysis of Variance (Anova). The Variance Ratio (VR) as calculated by the following formula: $VR=s_w2/s_b2$, where s_w2 is the intrapersonal variance (day-to-day food intake variation of the same individual) and s_b2 is the interpersonal variance (day-to-day food intake variation between two individuals). The equation proposed by Nelson *et al.*[23] was used for estimating correlation coefficient accuracy.

Table 1. Mean and standard deviation of energy and nutrient intakes determined by two 24-hour recalls of adolescents from public schools, according to gender. *Natal* (RN), Brazil, 2007-2008.

Nutrients		Mean	SD	Minimum	Maximum
Energy (Kcal)	Total	1911.4	745.6	505.6	5000.0
	M	1969.7	755.0	523.6	5000.0
	F	1852.4	732.3	505.7	4888.6
Carbohydrates (g)	Total	264.4	111.4	55.3	753.9
	M	272.1	112.1	55.3	753.9
	F	256.7	110.2	57.8	699.4
Lipids (g)	Total	62.9	30.9	9.4	249.6
	M	64.7	32.9	9.4	217.0
	F	61.2	28.8	10.5	249.6
Proteins (g)	Total	72.0	35.0	12.7	315.2
	M	75.9	36.8	20.0	315.1
	F	68.1	32.8	12.7	200.5
PUFA (g)	Total	14.2	7.9	1.1	74.4
	M	14.7	8.1	1.1	53.5
	F	13.7	7.6	1.2	74.4
MUFA(g)	Total	18.7	10.0	1.9	89.6
	M	19.5	10.5	1.9	76.0
	F	17.9	9.5	3.2	89.6
SFA (g)	Total	20.5	11.0	2.5	74.1
	M	21.0	11.6	3.6	74.1
	F	20.0	10.4	2.5	68.8
Fiber (g)	Total	20.6	12.9	1.9	90.5
	M	21.9	13.8	2.0	90.5
	F	19.2	12.0	2.8	77.6
Cholesterol (g)	Total	262.5	204.6	1.0	1355.1
	M	279.3	220.9	1.0	1355.1
	F	245.6	185.4	9.8	1131.9

Note: SD: Standard Deviation of the mean; M: Male; F: Female; PUFA: Polyunsaturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; SFA: Saturated Fatty Acids.

The number of days needed for estimating habitual nutrient intake was based on the hypothetical correlation (r)≥0.9 between the actual and observed nutrient intake, given by the formula proposed by Black *et al.*[9]:

$$D = \frac{r^2}{1 - r^2} \times \frac{S^2_w}{S^2_b}$$

D is influenced by intrapersonal and interpersonal variance ratios. If the intrapersonal variance observed during the day is smaller than its interpersonal counterpart, a smaller number of repeated measures will be needed. D also depends on the selected r. Thus, depending on r, the number of study days will be higher or lower.

RESULTS

Of the sample of adolescents (n=432), 83% (n=184) of the boys and 87% (n=182) of the girls answered the second 24hR. Boys presented higher mean energy and nutrient intakes but the difference was not significant (Table 1).

Considering all the nutrients, interpersonal sources of variance were greater than intrapersonal sources for both genders. Variance Ratios (VR) were less than one for all the nutrients and higher in the girls (Table 2).

The findings show an "r" close to the hypothetical correlation (r)≥0.9 for actual and

Table 2. Intrapersonal and interpersonal variations and variance ratio of adolescents from public schools, according to gender, *Natal* (RN), Brazil, 2007-2008.

Nutrients		Sources of variance		VR
		Intrapersonal	Interpersonal	
Energy (Kcal)	Total	383593.8	728799.3	0.53
	M	376053.3	763097.3	0.49
	F	391313.9	682009.9	0.57
Carbohydrates (g)	Total	8410.9	16419.0	0.51
	M	7951.4	17175.1	0.46
	F	8882.9	15447.2	0.58
Lipids (g)	Total	757.9	1159.9	0.65
	M	820.0	1340.7	0.61
	F	697.5	965.9	0.72
Proteins (g)	Total	949.8	1504.8	0.63
	M	989.1	1712.5	0.58
	F	912.6	1233.6	0.74
PUFA (g)	Total	54.1	69.3	0.78
	M	56.6	74.9	0.76
	F	51.8	62.4	0.83
MUFA (g)	Total	78.7	122.3	0.64
	M	78.4	141.3	0.55
	F	79.1	100.7	0.79
SFA (g)	Total	90.7	151.7	0.60
	M	94.8	172.5	0.55
	F	86.7	130.0	0.67
Fiber (g)	Total	115.7	221.7	0.52
	M	124.5	254.7	0.49
	F	107.3	180.9	0.59
Cholesterol (g)	Total	35637.1	48080.9	0.74
	M	41495.0	56054.1	0.74
	F	29921.2	38849.5	0.77

Note: VR: Variance Ratio; M: Male; F: Female; PUFA: Polyunsaturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; SFA: Saturated Fatty Acids.

Table 3. Correlation coefficients and number of days necessary for estimating the habitual energy and nutrient intakes of adolescents from public schools, according to gender, *Natal* (RN), Brazil, 2007-2008.

Nutrients		r^*	Days**
Energy (Kcal)	Total	0.89	2.26
	M	0.89	2.10
	F	0.88	2.43
Carbohydrates (g)	Total	0.89	2.17
	M	0.90	1.96
	F	0.88	2.47
Lipids (g)	Total	0.87	2.77
	M	0.88	2.60
	F	0.86	3.07
Protein (g)	Total	0.87	2.69
	M	0.88	2.47
	F	0.85	3.15
PUFA (g)	Total	0.85	3.33
	M	0.85	3.24
	F	0.84	3.54
MUFA(g)	Total	0.87	2.73
	M	0.89	2.34
	F	0.85	3.37
SFA (g)	Total	0.88	2.56
	M	0.89	2.34
	F	0.87	2.86
Fiber (g)	Total	0.89	2.22
	M	0.90	2.09
	F	0.88	2.51
Cholesterol (g)	Total	0.85	3.15
	M	0.85	3.15
	F	0.85	3.28

Note: *Considering days=2; **considering r=0.9.
M: Male; F: Female; PUFA: Polyunsaturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; SFA: Saturated Fatty Acids.

observed nutrient intakes. The number of 24hR necessary for determining habitual diet and assessing energy and nutrient intakes varied from two to three. Gender affected this finding significantly (Table 3).

DISCUSSION

The interpersonal variance found by the present study was the greatest source of nutrient intake variance, resulting in a VR of less than 1 and corroborating the findings of Laningan *et al.*[1] in children and Herbert *et al.*[24] in adults. The lack of variation in habitual dietary intake can be attributed to the low purchasing power and low education levels of the study population. Studies on food intake and dietary patterns done in other regions of Brazil found a VR greater than 1, stemming from higher intrapersonal variance[13,14]. This demonstrates that the daily food intake of an individual is a random event, even though a particular group displays a stable food intake pattern[24].

The variance ratios of the study sample were lower than those observed in Brazilian adolescents from the cities of *São Paulo*[14] and *Piracicaba*[13]. VR was higher in women, whose pattern was identical to that observed in female adolescents in Russia[7], but different from the VR found by other studies[7,14]. The best correlations between food consumption and outcome are observed in studies where VR is less than 1. These results are important for creating study designs that use dietary variable correlations as indicators of health and disease[7,23]. Moreover, the findings of the present study, obtained by appropriate statistical methods[25-27], may be useful for using VR to correct nutrient intake distribution based only on one 24hR per individual. The use of VR given by population studies with similar characteristics is an alternative to administering several individual 24hR to estimate habitual diet.

The number of days required for estimating the habitual diet of adolescents as a function of VR varied from two to three, being higher for females, except for energy intake. In both genders, carbohydrates and fibers require fewer study days. Among fatty acids, PUFA requires the highest number of study days and SFA the fewest. Hoffmann *et al.*[5] suggested that only two repeated measures of consumption would be necessary for estimating habitual intake, provided that data collection encompasses all seasons and days of the week.

This study did not assess the effect of month or day of the week. However, these variables have little influence on the estimation of the number of days required for determining

habitual diet. This suggests that day-to-day nutrient intake is random. Therefore, no specific month or day of the week can be recommended[14]. Furthermore, the contribution of macronutrient and total energy intakes during different seasons does not provide additional information[28].

Accurate assessment of food consumption poses a challenge, mainly due to dietary complexity, whose matrix has widely varying components and external factors. For these reasons, it is difficult to assess food intake without incurring into random and systematic errors, since they are inherent to individuals and the method used[4,21,29].

In this study, the rigorous methodological approach used for data collection, food intake analysis and databank updating confirms the reliability of the results. When food consumption protocols are monitored more closely, especially during data collection, greater accuracy is achieved and fewer days are necessary for estimating the habitual intake of individuals and populations[2].

In conclusion, interpersonal variation was greater than intrapersonal variation for all nutrients, resulting in a variance ratio of less than 1. The number of 24hR needed for determining the habitual diet of adolescents varied from 2 to 3, depending on nutrient and gender. Estimates of variance ratios found by the present study may be of use in other investigations with adolescents with similar socioeconomic and cultural characteristics.

ACKNOWLEDGEMENTS

We thank the *Pro-Reitoria de Pesquisa*, of the *Universidade Federal do Rio Grande do Norte*, Municipal Secretariat Education of *Natal*, *Rio Grande do Norte*, and the nutrition students who participated in data collection: Aline Tuane Oliveira da Cunha, Ingrid Freitas da Silva and Suzylane Annuska Guerra da Silva.

COLLABORATORS

LFC PEDROSA and SCVC LIMA were responsible for conceiving the study, collecting, analyzing and interpreting data and reviewing the manuscript. CO LYRA, LGB PINHEIRO and CMM MORAIS participated in data collection, analysis and interpretation, and in the review of the final manuscript. KCM SENA-EVANGELISTA and B SLATER participated in data analysis and manuscript review.

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Received on: 11/4/2012
Final version on: 11/10/2012
Approved on: 12/11/2012

Diet assessment in the Brazilian Longitudinal Study of Adult Health (ELSA-*Brasil*): Development of a food frequency questionnaire

Avaliação da dieta no Estudo Longitudinal de Saúde do Adulto (ELSA-Brasil): desenvolvimento do Questionário de Frequência Alimentar

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ABSTRACT

Objective

The objective of this article is to present the development of the Food Frequency Questionaire used in the Longitudinal Study of Adult Health-Brazil and analyze how diet exposes individuals to cardiovascular diseases and type 2 diabetes *Mellitus*.

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Methods

The Longitudinal Study of Adult Health-Brazil dietary assessment instrument is based on a previously validated Food Frequency Questionaire and the final list of items took into consideration a study done in the six Longitudinal Study of Adult Health-Brazil investigation centers.

Results

New foods/preparations were included in the Food Frequency Questionaire with their respective portions, totaling 114 items. The perspectives of dietary analysis and cardiovascular diseases and diabetes are presented in Longitudinal Study of Adult Health-Brazil.

Conclusion

A new instrument was developed to cover the regional particularities of the study population.

Indexing terms: Chronic disease. Food consumption. Nutrition surveys.

RESUMO

Objetivo

Este artigo tem por objetivo apresentar o desenvolvimento do Questionário de Frequência Alimentar utilizado no Estudo Longitudinal de Saúde do Adulto e as perspectivas de análise da dieta, como exposição a doenças cardiovasculares e diabetes Mellitus *tipo 2.*

Métodos

O instrumento de avaliação dietética do Estudo Longitudinal de Saúde do Adulto foi construído a partir de um Questionário de Frequência Alimentar previamente validado. A lista final de itens alimentares levou em consideração um levantamento realizado nos seis centros de investigação do estudo em questão.

Resultados

Foram incluídos novos alimentos/preparações no Questionário de Frequência Alimentar, com as respectivas porções, perfazendo um total de 114 itens. São apresentadas as perspectivas de análise da dieta e doenças cardiovasculares e diabetes no Estudo Longitudinal de Saúde do Adulto.

Conclusão

Desenvolveu-se um novo instrumento que busca atender especificidades regionais contempladas na população do estudo.

Termos de indexação: *Doença crônica. Consumo de alimentos. Inquéritos nutricionais.*

INTRODUCTION

Dietary aspects have been associated with cardiovascular diseases[1] and type 2 diabetes *Mellitus*[2]. The role of diet as main risk factor, confounding variable, or effect modifier between other factors and these diseases has been analyzed by the main cohort studies in the world. These analyses are based on the results of studies that used dietary questionnaires, especially Food Frequency Questionnaires (FFQ) based on that developed by Willett *et al.*[3] and Block *et al.*[4].

The Nurses Health Study (http://www.channing.harvard.edu/nhs/), which began in 1976 and enrolled 238,000 American nurses, initially aimed to study the use of oral contraceptives and cancer[5]. After four years, a dietary questionnaire was included in the study. Among the results, more than 300 publications reported associations between diet and different outcomes. A recent study of this cohort showed that adherence to a Mediterranean dietary pattern is a protective factor against Cardiovascular Disease (CVD) incidence and mortality[6]. The following associations were observed: between fat intake and decline of cognitive function in diabetic women[7]; between adherence to the Dietary Approaches to Stop Hypertension (DASH) diet and

lower incidence of self-reported hypertension in young women[8]; and between the intake of long-chain fatty acids and fish and lower incidence of type 2 diabetes *Mellitus*[9]. Fruit and vegetable intake is associated with a lower occurrence of ischemic cardiovascular diseases in women with moderate carbohydrate intake[10].

The findings of the Framingham study were relevant for the current knowledge on CVD prevention and contribute significantly to clinical practice (http://www.framinghamheartstudy.org)[11]. Meanwhile, the Whitehall study (http://www.ucl.ac.uk/whitehallII) has valued the longitudinal analysis of dietary patterns found by FFQ and their association with the incidence of CVD and type 2 diabetes *Mellitus*[12,13].

Multicausality, the difficulty of determining the diet and the countless potentialy interactions with sociodemographic and lifestyle factors make the association between diet and the incidence of CVD and type 2 diabetes *Mellitus* complex, but the importance of this analysis is illustrated by the systematic review of 11 studies that use FFQ to verify the association between intake of fatty acids and carbohydrates and risk of CVD. In the cited review, replacing 5% of the total energy from saturated fatty acids with polyunsaturated fatty acids was inversely associated with risk of ischemic heart disease. However, replacing the same 5% of the total energy from saturated fatty acids with carbohydrates showed a modest but positive association with ischemic heart disease[1].

The Longitudinal Study of Adult Health (*Estudo Longitudinal de Saúde do Adulto* - ELSA-*Brasil*) is a cohort, multicentric and interdisciplinary study that aims to assess the complex network of risk factors associated with CVD and type 2 diabetes *Mellitus*, including diet. The ELSA cohort consists of 15,105 participants aged 35 to 74 years, employees and retirees of the following six teaching and research institutions: *Universidade Federal da Bahia, Universidade Federal do Espírito Santo, Universidade Federal de Minas Gerais, Universidade de São Paulo, Fundação Oswaldo Cruz* and *Universidade Federal do Rio Grande do Sul*.

The ELSA-*Brasil* is a prospective cohort structured on an emerging country with great dietary diversity which is undergoing changes that may have promoted obesity, among other determinants of chronic diseases, and Brazilian dietary practices[14]. The option of using a FFQ in ELSA-*Brasil* is based on the supposition that the mean dietary intake during a relatively long period, for example, the previous year (used in ELSA-*Brasil*) is a more representative exposure that the dietary intake of a few days[3]. Even if limited by exposure time, individuals seem to maintain a consistent intake pattern during adulthood, so the intake during the last year probably reflects the dietary pattern of a longer period.

Although important and necessary, a consensus could not be reached on the dietary assessment method to be used by ELSA-*Brasil*. After discussing how to make this assessment, if by a FFQ, a method commonly used in longitudinal studies, or by many 24 hour food recalls, the FFQ method was chosen. Although the limitations of their use are known, FFQ have many advantages over other assessment methods, such as: simple to analyze, inexpensive, does not induce changes in food intake since it collects food intake data over time, minimizes intra-individual variation, provides food data directly and can improve the analysis of nutrients with high intra-individual variation[15].

The objective of this article is to present the development of the FFQ used in the first phase of ELSA-*Brasil* and the perspectives of dietary analysis, such as cohort exposure to CVD and type 2 diabetes *Mellitus*.

Food frequency questionnaire ELSA-*Brasil*

Longitudinal Study of Adult Health-Brazil used a semi-quantitative FFQ with 114 items for assessing the food intake of the participants in

the last twelve months. A sample question is: "How often do you eat rice? Please refer to your habitual intake in the last 12 months".

The Food Frequency Questionnaire ELSA-*Brasil* was based on a FFQ developed in Brazil during the 1990s with a list of foods extracted from 1974-1975 population surveys, including items that represented 86% of the energy, 84% of the vitamin A and 76% of the vitamin C consumed at the time[16]. It performed similarly to instruments used in other large studies[17]. In addition to the original food items, new food items were included in the FFQ ELSA-*Brasil* to reflect the dietary changes that have occurred in the last 20 years.

Chart 1 shows the FFQ ELSA-*Brasil* template. It consists of three components: 1. Foods/preparations; 2. Portion sizes; and 3. Intake frequencies, with 8 frequency options varying from "More than 3x daily" to "Never/Almost never". In order to include seasonal consumption, one more column was included where it is possible to record the occurrence of spontaneous manifestation, such as "only during a certain period", "only during the season", or any other expression that indicates regular consumption during a certain time of the year.

List of foods and/or preparations

The original FFQ was developed in *Rio de Janeiro* and did not include regional foods. Consequently, a previous study used 24 hour recalls in the six ELSA study centers. A total of

Chart 1. Template of the Food Frequency Questionnaire of the Longitudinal Study of Adult Health (ELSA-*Brasil*)*, 2008.

DIETA (QFA)

"Now let's talk about your habitaul food intake during the last 12 months. We would like to know what you eat and drink daily, weekly or monthly, as shown in this card. [Present the card DIE 01]
I will read food by food. Tell me which ones you consume and how much of each.
These utensils will be used to help to quantify the foods and beverages. [Present the utensils.]
May we begin?

"I am going to start by listing the foods in the Group breads, grains and tubers.Pleaser report your habitual intake during the last 12 months".

"How often do you eat or drink [say the name of the food]?" If the interviewee does not specify a frequency, ask: "How many times a day, week or month?" "And how many [say the corresponding cooking unit showing the utensil] do you eat or drink?" Repeat these instructions for all foods.

	Food	Amount eaten each time	More than 3x/day	2 to 3x/ day	1x/day	5 to 6x/ week	2 to 4x/ week	1x/ week	1 to 3x/ week	Rarely/ Never	Reported seasonal intake
1	Rice ( ) Whole ( ) White	- Serving Spoon									
2	Oats/Granola/Bran/Other Grains	- Serving Spoon									
3	*Farofa*/Savory couscous/*Paulista* couscous	- Full Tablespoon									
4	Manioc (Casava) Flour/Commeal	- Full Tablespoon									
5	Light Bread (White or whole)	- Slice (25g)									

Note: *Study done in the following six teaching and research institutions: *Universidade Federal da Bahia*, *Universidade Federal do Espírito Santo*, *Universidade Federal de Minas Gerais*, *Fundação Osvaldo Cruz*, *Universidade Federal do Rio Grande do Sul* and *Universidade de São Paulo*.

100 24 hour recalls were administered to individuals ineligible for the study, but with characteristics similar to those of the ELSA study participants (same age group, gender and work location). Trained interviewers administered 50 24 hour recalls to individuals with higher education and 50 to individuals with elementary school education. Among the correctly assessed 24 hour recalls, half regarded one weekday (Monday to Friday) and the other half one weekend day (Saturday or Sunday). In order to standardize the administration of the 24 hour recalls, a specific protocol with an instruction manual was developed and a picture album with food portions and utensils was used together with the recalls. After the analysis, the frequencies of the items recorded in the forms were determined.

In addition to the foods in the original version[16], the preliminary list of foods in the FFQ ELSA-*Brasil* contained food/preparations and beverages recorded in these 24 hour recalls (for example, rice, beans) with consumption frequencies greater than 10%. Later, the inclusion of typical or common foods in each state of the study was considered, and the researchers decided to include up to two regional items or markers of differentiated consumption, such as: food typical from *Bahia* and *acarajé* (BA), *chimarrão* and *cuca* (RS), *Paulista* couscous and Japanese food (SP); *feijoada* (RJ); cheese bun and *tropeiro* beans (MG) and *Capixaba* seafood stew and fried plantains (ES). Regional synonyms and designations for different foods were also included, such as *pão francês* and *cacetinho* for French bread roll, *tangerina* and *bergamota* for mandarin, *doce de fruta* and *chimia* for a type of jam, *mandioca* and *aipim* for cassava, and *polenta* and *angu* for *polenta*.

Increasing the number of items from the original questionnaire increases the probability of overestimating intake[3] and the time needed for administration. In order to adjust the size of the FFQ administered at the ELSA Investigation Centers (IC) to what seemed a reasonable size and minimize participant tiredness, some items were grouped as shown in Chart 2. The grouping of items obeyed the rule of similar nutritional content, that is, foods were grouped with other foods with similar nutritional composition, and the intake characterization rule, that is, foods consumed in similar situations and commonly used for replacing each other were also grouped.

Eleven items added to the FFQ also received options for type: rice could be white or whole, cookie could be plain or sandwich, fruit salad could be with sugar or dressing or without sugar or dressing, mayonnaise could be regular or light, milk could be whole, skimmed, semi-skimmed or soy milk, yogurt could be regular or light, cream cheese (*requeijão*) could be regular or light, food from *Bahia* could be *vatapá*, *caruru* or fish stew, Japanese food could be sushi, sashimi, tofu or yakisoba, soda could be diet, light or regular and wine could be red or white.

In order to improve the assessment of sweetened beverages without increasing the number of items, the option "without sugar/with sugar/with sweetener" was added for five beverages: coffee, natural juice, processed juice, and tea/mate. The participant would choose the version consumed most often in the last 12 months.

Finally, all items selected for the FFQ ELSA-*Brasil* were organized into the following seven food groups for FFQ administration: breads/grains/tubers; fruits; vegetables/legumes; eggs/meats/milks/dairy products; pasta/other preparations; sweets; and beverages. Hence, the version used in the first phase of the ELSA-*Brasil* was concluded with a list of 114 food items.

Portion sizes

Some cooking units of the original FFQ[16] were changed after administration of the 24 hour recalls. For each item, the cooking unit used most often was used. The amount in grams (g) or milliliters (mL) for each cooking unit was taken

Chart 2. List of food groups of the Food Frequency Questionnaire of the Longitudinal Study of Adult Health (ELSA-*Brasil*), 2009.

Group	Grouped foods
Breads, Grains and Tubers	Oat/Granola/Bran/Other grains. *Farofa*/Savory couscous/*Paulista* couscous. Cassava flour/cornmeal. French bread roll/Bread loaf/Syrian bread/toast. Sweet bread/Homemade bread. Stuffed cake/pie/trifle/*cuca*. *Polenta/angu/pirão*. Cooked potato/potato stew/mashed potato. Potato/cassava/banana/*polenta*/sweet potato/French fries.
Fruits	Orange/mandarin/tangerine/Ponkan. Apple/pear. Peach/plum/kiwi/cashew apple/*Spondias mombin*/nectarine. Persimmon/jack fruit/pine nuts/custard-apple.
Vegetables and legumes	Steamed cabbage/spinach. Chicory/watercress/arugula/cabbage/endive/chard/raw spinach. Zucchini/chayote/eggplant. Lentils/Chickpeas/Peas.
Eggs, meats, milks and dairy products	Fried egg/omelet/scrambled eggs. *Frescal Minas* cheese/ricotta/cottage/buffalo mozzarella. Standard *Minas* cheese/mozzarella/*Prato*/cheddar/*canastra*/Processed. Liver/organ meats. Chicken breast/genetically improved chicken/turkey. Sausage/spicy sausage. Blanquette/turkey breast/breast from genetically improved chicken. Ham/*mortadella/capicola/salami/pâté*. Bacon/lard/crackling. Cooked fish/*Capixaba* seafood stew/baked fish/fish stew/grilled fish. Sardine/tunaShrimp/mussel.
Pasta and other preparations	*Feijoada/tropeiro* beans.
Sweets and beverages	Cocoa powder/chocolate milk/Capuccino.

from a standard reference table proposed by Pinheiro *et al.*[18]. When the cooking unit most often cited in the 24-hour recalls was not found in the table, it was measured in the laboratory by a precision scale and appropriate methodology. This same procedure was used for developing cooking unit equivalents when the interviewee was unable to report intake in cooking units.

A checklist was created for some food groups and placed in the general ELSA-*Brasil* questionnaire right after the FFQ. These are food habit-related questions, such as "How often do you eat fast food (pizza, sfiha, kibbeh, *coxinha*, hamburger, *acarajé*?;" six with the same frequency options as the FFQ and eleven with specific answers, such as: "What type of sweet do you consume most often?" and "What kind of cooking oil do you use at home to cook/prepare foods?"

The present study was approved by the National Research Ethics Committee under protocol number 15065 *Comissão Nacional de Ética em Pesquisa* (CONEP) and by all Research Ethics Committees of the participant institutions. All participants signed a free and Informed Consent form before entering the study.

Administration of the FFQ ELSA-*Brasil*

ELSA-*Brasil* is the first Brazilian study to use a FFQ filled out online during the participants' interviews. The construction of the online version

allowed controlling input by establishing minimum and maximum acceptable limits for each one of the 114 items and avoiding errors while filling out the instrument, such as skipping questions and leaving blank answers. The probable equivalency of each food item or beverage could be shown while asking about it, helping the interviewer to select the appropriate cooking unit.

A list of foods was read to the participants and they were asked which ones they consumed habitually in the last twelve months and how many times a day/week/month they consumed them. An answer card size A4 was provided to facilitate selection and keep the participants from having to memorize the options. Additionally, a kit of utensils was used during FFQ administration. The answer card shown to the participant had the frequencies grouped as daily, weekly or monthly consumption. Utensils that represented a standardized portion in the FFQ were shown to the participants during the interviews to help of estimation the amount of food, preparations and beverages consumed.

The interviewers were trained and certified by ELSA researchers. Also, during the study, interviews were periodically followed by an IC supervisor, according to the instruction manual. After introduction to the FFQ and training, the interviewers were theoretically and practically assessed before being considered apt and certified for FFQ administration. The interviews were periodically taped for quality control and some interviews were randomly chosen for assessment of interviewer performance by the local supervisors.

Analysis of the dietary data

The Food Frequency Questionnaire ELSA-*Brasil* uses the Nutrition Data System for Research (NDSR) table and *Tabela Brasileira de Composição de Alimentos* (TACO) (http://www.unicamp.br/nepa/taco/) for calculating the dietary nutrients. The NDSR database contains more than 18,000 foods and 7,000 processed products. The database also allows the user to pick ingredients and preparation methods for better results. The nutritional composition of the 114 items listed in the FFQ ELSA-*Brasil* and their variations was taken from the NDSR. The current NDSR version includes 160 nutrients and other food components. New nutrients and components are constantly added to meet the emerging research needs.

The consensus is that the FFQ has some limitations since the participants need to recall the amount and frequency of the foods consumed in the last twelve months. Therefore, this method depends on the participant's memory over a relatively long period.

Additionally, it is possible that recent or current dietary habits are cited in place of those practiced during the study period (last twelve months)[19]. Another limitation is related to the accuracy of the amount consumed, since in the FFQ the participant must report intake based on a preestablished cooking unit. The use of an equivalence list may reduce this problem by allowing the participant to report an alternative cooking unit during the interview. The loss of food intake details is also reported in studies that use the FFQ[3,19].

One way to minimize some of the problems associated with the FFQ is method calibration, which is possible by using food records from validation studies with 300 participants in the six IC (in press).

Perspectives of diet analysis in ELSA-*Brasil*

The analysis of dietary data leads to the quantification of energy, nutrients, foods and food groups, in the classification of individuals according to food intake and in the identification of dietary patterns. These allow testing hypotheses between dietary associations and different outcomes or diseases. Important components for understanding the relationship between diet and

CVD, diabetes and obesity, such as different dietary fatty acid profiles or dietary glycemic index, only to mention a few, may also be explored and better apprehended in this analysis.

It is possible to identify many diet analysis possibilities and important contributions to the knowledge about the relationship between diet and the chronic diseases present in the Brazilian population. In addition to investigating this issue in a population rather different from those of other longitudinal studies, ELSA-*Brasil* will test hypotheses generated in Brazilian cross-sectional studies that contemplate diet as a factor of exposure to certain diseases, such as the influence of combining rice and beans on obesity[20,21].

Although significant accumulated knowledge on the theme already exists, nearly all cohort studies that analyzed these relationships were done in the Northern Hemisphere, including the United States and European countries. Hence, there is a great scarcity of information on the association between diet and CVD in countries similar to Brazil in ethnic diversity combined with recent nutrition transition, common in emerging countries[22]. Both the prevalence and the consequences of these diseases in Brazil are different from those of developed countries. Therefore, one of the main contributions of this analysis will be to identify specific characteristics of the Brazilian diet and their relationship with other specific factors of the Brazilian population and with the outcomes studied in ELSA-*Brasil*.

One of the study strengths is the possibility of assessing diet using a FFQ sensitive to regional variations. Another ELSA-*Brasil* advantage is the collection of repeated measures with regular periodicity, constituting an extremely important condition for the long-term dietary assessment and the relationship between diet and chronic diseases. An important contribution of this study will be the identification and exploration of regional differences and their impact on certain equally regional outcomes, regardless of other lifestyle factors.

Another important contribution of ELSA-*Brasil* is the possibility of measuring the urinary excretion of sodium in 12 hours, allowing the study of the correlation between sodium excretion and diet. Together, these tools will provide a very thorough dietary analysis and improve the knowledge about the relationship between diet and CVD and diabetes in Brazil. Brazilians inherited from the Portuguese the habit of consuming too much salt[23], making hypertension an important risk factor for cardiovascular diseases and consequently, for fatal strokes[24,25].

Other possible analyses include the use of scores that compare ELSA participants' diets with other diets known to protect against CVD, such as the Mediterranean and DASH diets. Trichopoulous et al assessed adherence to the Mediterranean diet in adult Greeks using a scale from 0 to 9 (9 = total adherence and 0 = no adherence) and found that greater adherence was associated with lower mortality from ischemic heart disease and cancer[25]. Fung *et al.*[26] observed an inverse association between the DASH score based on eight food/nutrient groups (fruits, vegetables, whole grains, nuts, low-fat dairy products, red and processed meats, sweetened beverages and sodium) and stroke[26]. This type of association is perfectly reproducible in ELSA.

ELSA-*Brasil* includes a broad battery of tests for cognitive assessment (memory, semantic and phonemic fluency and executive functions). A recent study showed that adherence to a Mediterranean-like diet was associated with smaller age-related cognitive decline[27]. Another study showed that a high intake of n-3 fatty acids reduced verbal fluency decline in individuals with high blood pressure and diabetics[7]. Féart *et al.*[27] showed that good adherence to the Mediterranean diet was associated with a smaller cognitive decline according to the mini-mental state examination. Bearing these results in mind, it will be possible not only to assess the association between diet and cognitive decline using ELSA data, but also to compare the results with other similar studies.

ELSA-*Brasil* also allows assessing FFQ performance in populations other than those that participated in validity studies in developed countries. If a validity study is done, it will be possible to use it in other investigations in the Brazilian population. This validity study was designed to determine if the newly created FFQ classifies individuals into different intake levels well. Three hundred participants were studied in the six IC (50 in each center) using the food record method as reference. Each participant recorded all foods and beverages consumed within 24 hours on three different occasions (October, March and August), with regular intervals during twelve months. Since the ELSA sample includes three occupational categories (support, technical and higher education levels), it is possible to analyze the FFQ performance according to these categories, as well as in relation to education level, age group and gender.

The risk factors for CVD have different distributions in different countries and diet is one of the factors that most contributes to this difference, as shown by the Seven Countries Study[28,29]. In addition to allowing comparisons among the six centers, ELSA allows comparing how diet is a risk factor for CVD in Brazil and developed countries. This piece of the puzzle that ELSA begins to unveil can be added to the existing knowledge to construct a more complete picture of the distribution of CVD and diabetes and their global risk factors. As mentioned by Willett *et al.*[15], developing countries usually have unique dietary characteristics and variations, and possibly different genetic susceptibilities to the effect of diet that justify the performance of well-designed cohort studies in these populations.

ACKNOWLEDGMENTS

The present study was possible thanks to the technical and financial support provided by the Ministry of Health, Department of Science, Technology and Strategic Inputs, Department of Science and Technology, Ministry of Science and Technology, National Council for the Development of Science and Technology, Sponsor of Studies and Projects to the Longitudinal Study of Adult Health ELSA-*Brasil*.

CONTRIBUTORS

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Received on: 18/7/2012
Final version on: 4/10/2012
Approved on: 13/11/2012

Experimental diet based on the foods listed in the Family Budget Survey is more detrimental to growth than to the reflex development of rats[1]

Dieta experimental baseada em alimentos listados pela Pesquisa de Orçamento Familiar é mais agressiva ao crescimento que ao desenvolvimento reflexo de ratos

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ABSTRACT

Objective

The present study assessed the pregnancy and lactation performances of rats fed an experimental diet based on the foods listed in the Family Budget Survey (*Pesquisa de Orçamento Familiar*) 2002/2003 and the impact of said diet on the growth and development of the pups until weaning.

Methods

Wistar (n=12) rats were randomly divided into two groups: a control group (control group, n=6) fed a commercial chow (Labina®, Brazil) and an experimental group (n=6) fed the Family Budget Survey diet during the entire pregnancy and lactation period. All animals had free access to food and water during the entire study period.

[1] Article based on the thesis of MF CARVALHO, entitled "Experimental diet based on the foods listed in the Family Budget Survey (POF) - 2002/2003 given during pregnancy and lactation: repercussions on the reproductive performance and physical and biochemical parameters of rat pups". Universidade Federal de Pernambuco; 2012.

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Results

The Family Budget Survey diet increased the duration of pregnancy (control group=21.00±0.00; POFG=21.57±0.55, p=0.025) and made the dams lose weight during the lactation period (control group=27.92±18.47g; POFG=-15.66±16.90g). The Family Budget Survey group presented low food, energy and nutrient intakes during pregnancy, which became even lower during lactation. Pups from Family Budget Survey dams presented lower body weight at weaning (control group=52.38±4.49g; POFG=39.88±2.78g, p=0.001) and lower nose-to-anus length (control group= 117.37±0.64mm; POFG=125.62±0.96mm, p=0.001). However, some physical milestones and reflexes occurred earlier, such as the placing response reflex [control group= 12.00 (9.00-15.00) days; POFG=9.50 (9.00-14.00) days] aerial righting reflex [control group=18.00 (17.00-20.00) days; POFG=16.00 (13.00-18.00) days] and unfolding of the external ear [control group=3.00 (3.00-3.00) days; POFG=2.00 (2.00-3.00) days].

Conclusion

The Family Budget Survey diet seems to be more detrimental to the physical growth of the pups than to their brain growth, according to the assessed reflexes and physical milestones and measures. This may be due to the low protein content of the diet for rat reproduction and growth combined with adequate fat and essential fatty acid contents. Providing an adequate amount of protein to the Family Budget Survey diet may normalize pup growth.

Indexing terms: Diet. Growth. Lactation. Rats.

RESUMO

Objetivo

O estudo se propõe avaliar os desempenhos de prenhez e lactação de ratas alimentadas com dieta experimental baseada nos alimentos adquiridos para consumo pela Pesquisa de Orçamento Familiar 2002-2003 e as repercussões no crescimento e desenvolvimento da prole até o desmame.

Métodos

Ratas Wistar (n=12) foram aleatoriamente divididas em dois grupos experimentais: um grupo-controle alimentado com dieta comercial Labina®, Brasil (n=6) ou dieta experimental (n=6) por toda gestação e lactação. Ração e água foram oferecidas ad libitum por todo período.

Resultados

A dieta Pesquisa de Orçamento Familiar na gestação e lactação aumentou a duração da gestação (grupo-controle=21,00±0,00; GPOF=21,57±0,55, p=0,025) e induziu uma variação negativa de peso nas mães ao final da lactação (grupo-controle=27,92±18,47g; POFG=-15,66±16,90g). Durante a gestação houve redução no consumo de alimentos, energia e nutrientes, exceto de lipídios no grupo experimental Pesquisa de Orçamento Familiar e esta foi intensificada na lactação. A prole proveniente das mães com dieta Pesquisa de Orçamento Familiar apresentou menor peso corporal ao desmame (grupo-controle=52,38±4,49g; POFG=39,88±2,78g, p=0,001) e menor comprimento naso-anal (grupo-controle=117,37±0,64mm; POFG=125,62±0,96mm, p=0,001). No entanto, o desenvolvimento físico e reflexo não mostrou diferenças em alguns resultados ou apresentou adiantamento como observado na colocação pelas vibrissas [grupo-controle: 12,00 (9,00-15,00) dias; POFG=9,50 (9,00-14,00) dias] e queda livre [grupo-controle:18,00 (17,00-20,00); POFG=16,00 (13,00-18,00) dias], bem como da abertura do pavilhão do conduto auditivo [grupo-controle=3,00 (3,00-3,00); POFG=2,00 (2,00-3,00) dias].

Conclusão

A dieta Pesquisa de Orçamento Familiar parece causar maior agressão ao crescimento somático que ao desenvolvimento cerebral da prole avaliado pela ontogênese reflexa e os caracteres físicos. Estas resultantes podem estar associadas a uma possível inadequação proteica da dieta para o período de reprodução e crescimento dos ratos em conjunto com suficiente aporte de lipídeos e ácidos graxos essenciais. Sugere-se que uma adequação de proteína na dieta Pesquisa de Orçamento Familiar possa promover apropriado crescimento somático da prole.

Termos de indexação: *Dieta. Crescimento. Lactação. Ratos.*

INTRODUCTION

Growth, development and reproductive performance are crucial indicators of dietary adequacy[1]. In this context, protein adequacy stands out because protein seems to be more critical than energy for a satisfactory reproduction[1]. The sum of low protein intake plus low food intake may be highly detrimental to the developing organism. In rats, the first postnatal weeks, that is, the lactation period, corresponds to the period of greatest vulnerability of the nervous system to environmental insults given the speed with which neurogenesis, synaptogenesis and cell morphology occur[2]. During this time, appropriate nutrient availability, especially proteins[2] and fats[3], is essential for the development of the central and peripheral nervous systems[2].

Protein is essential not only for the maturation of the nervous system but also a determinant of cranial and body growth[4]. Its availability depends on appropriate protein intake by dams and quality of the protein source, consequently, the bioavailability of essential amino acids. Hence, low protein intake affects pregnancy and lactation performance, and the protein content of the dam's milk[5,6]. There are numerous reports in the literature about the relationship between protein quality[7] and quantity[2,5,6,8] in the dam's diet and the changes it causes on the somatic, metabolic and functional systems of the dam and her offspring.

The importance of fats for the dam's performance[9] and offspring's maturation and nervous system development[10] has also been reported. However, fat quantity[11,12] and type[12,13] impact both the energy density of the diet and the availability of essential fatty acids. Thus, the beneficial and/or adverse repercussions of dietary fats are directly associated with their quantity, quality and fatty acid ratios.

Fats have been the focus of many studies not only because of their importance for body development but also because of their growing participation in the human diet. There are clear associations between excess fat intake, especially saturated fat, and the development of overweight, obesity and related metabolic diseases. Based on this premise, experimental high-fat diets have been developed to induce excess weight and metabolic disorders in rats. One of the most common is the cafeteria diet, whose aim is to induce eating disorders and excess weight gain in the offspring[14]. Most cafeteria diets that combine commercial chow with high-fat foods culminate with the dilution of some nutrients, especially protein, making the diet unsuitable for the animal's growth and development[15]. Additionally, the use of these diets during pregnancy and/or lactation results in unsatisfactory dam and offspring performance[16,17].

In Brazil and other developing countries, the phenomenon known as nutrition and epidemiological transition reduced the rates of malnutrition and increased the rates of overweight and obesity in all age groups[18]. Concomitantly, the foods purchased by the population according to the greatest national survey, the Family Budget Survey (*Pesquisa de Orçamento Familiar* - POF) from 2002/2003 and 2008/2009[18] points out relevant dietary changes. According to the POF (2002/2003), intakes of total and saturated fats, simple sugars and proteins are higher than those found by the last surveys done in the 1970s. Meanwhile, the POF (2008/2009) found that protein intake did not increase, but total fat intake increased slightly. However, this increase was still within the recommended fat intake ranges (total and saturated fats not exceeding 30% and 10% of the total energy intake, respectively). On the other hand, the percentage of energy coming from simple sugars increased, exceeding the maximum recommended amount by 7%. According to Levy-Costa *et al.*[19], these Brazilian dietary trends and patterns are related to the higher rates of obesity and non-communicable chronic diseases in the country.

However, these changes in the Brazilian dietary pattern have not been studied in animal models. Likewise, there are no reports of their consequences during the critical growth and development periods of rats. Therefore, the present study assessed the effects of an experimental diet based on the foods most commonly purchased by Brazilians on the dam's performance and offspring's growth and development until weaning. The commercial chow Labina® was chosen as the control diet because it is made from natural products, such as cereal grains and meatmeal, so it is similar to the experimental diet. According to the National Research Council[1], diets can be classified as chemically defined, purified/semipurified and natural, according to their ingredients.

METHODS

Experimental groups and environmental conditions

This study was approved in 2008 by the Committee of Anunal Experimental of the Center of Biological Siences, *Universidade Federal de Pernambuco* (UFPE) under protocol number 23076.004773/2008-42. Albino Wistar rats (*Rattus novergicus*) were obtained from the bioterium of the UFPE Departament of Nutrition and housed in a colony room at 22±1°C and 12 hour light/dark cycle (lights on at 6:00 a.m.), with free access to food (Labina®, *Agribands Purina do Brasil Ltda, Paulínia*, SP, Brazil, or the experimental diet) and water.

Nulliparous rats (n=13) aged 90 to 120 days and weighing 240±20g were mated with male rats of the same line and origin, in the proportion of 1 female to 2 males. The rats were considered pregnant when sperms were present in their vaginal discharge, collected by vaginal smear[20]. Their weights were then followed regularly. The rats were randomly divided into two groups, a Control Group (CG) fed with the commercial diet and an experimental group (POFG), fed with the POF 2002/2003-based diet. Each group had 6-7 pregnant rats which were kept in individual polypropylene cages with ad libitum access to food and water during the entire pregnancy and lactation periods.

Twenty-four hours after delivery, the pups were weighed and the litter size was adjusted to 6 pups per litter for better lactational performance[21], in the proportion of 3:3 or 4:2 males to females.

Diet

The experimental diet was based on the foods most commonly consumed by Brazilians according to the POF of 2002/2003. The food items used for preparing the diet and the relative participation of each macronutrient, food and food group to the total energy was based on the mean national values published by Levy Costa *et al.*[19]. The percentage caloric contribution of the foods that were not included in the experimental diet were redistributed to ensure the total contribution of each food group and each food was increased by 0.08% to represent the group ready-to-eat meals. The experimental diet was prepared from the most representative, inexpensive and easy-to-prepare foods of each food group.

The amount of raw foods in grams was proportional to the percentage contribution of each group to the total energy of the diet. A cooking factor was then used on the foods that required cooking to determine the correct amount of cooked food that should compose the diet.

The final composition of the diet was as follows, in grams per 100g of feed: white rice (type 1) - 17.50; French bread roll - 10; cornstarch cookie - 6; wheat flour - 6; pinto beans - 6; potato - 3; cassava flour - 3; beef - 5; skinless, boneless chicken breast - 3.5; whole milk - 5.2; banana flour - 1.6; dried onions - 0.60; soybean oil - 6.5; salted margarine (65% fats) - 3; lard - 0.5; white sugar - 13.50; Coca-Cola - 6.8; dried coconut - 0.2; tomato sauce - 1.4; chicken stock -

0.5; cake mix - 0.20. All foods were from the same brands and bought at the same location. Food moisture was removed by placing them in a ventilated incubator at 50-60°C for 24 hours. The resultant flours per 100g of feed (%) were used to prepare the experimental feed. Once the flours of the cooked foods were ready, they were mixed with the other flours in a plastic bowl and sieved three times. The soft and fluid foods were carefully added to the flour mix in the following sequence: tomato sauce, lard, margarine, oil, chicken stock and the broth obtained from cooking the meat (100mL of broth for 1kg of feed). The mixture was then homogenized. The homogenate was placed in a ventilated incubator at 50-60°C for another 24 hours for drying and pellet formation. The centesimal compositions of the flours (potato, chicken and meat) and of the dried homogenate were determined at the Laboratory for Food Esperimentation and Analysis (*Laboratório de Experimentação e Análisis de Alimentos* - LEAAL) of the UFPE Department of Nutrition. No vitamin or mineral supplement was added to the POF diet. The fatty acids were determined by gas chromatography (Shimadzu GC-14B, Japan) with a Flame Ionization Detector. The column was a SUPELCOWAX (30mx0.25mmx0.25mL) column with a helium flow of 1.3mL/min, split ratio of 20:1 and a run time of 60 minutes. Chart 1 shows the fatty acid contents of the commercial and POF diets.

This study did not use the foods listed in the POF 2008/2009 because the experiments had

Chart 1. Percentage composition of fatty acids in relation to the total fat content of the diets. *Recife* (PE), Brazil, 2011.

Fatty acids	Standard diet[1]	Experimental diet based on the Family Budget Survey[1] (POF)
C4:0	ND	0.26
C6:0	ND	11.00
C10:0	ND	0.37
C12:0	ND	0.27
C14:0	ND	1.40
C15:0	ND	1.76
C16:0	ND	15.30
C18:0	ND	5.80
C23:0	ND	0.24
Σ SFA	**27.41 ± 0.85**	**36.41**
C16:1	ND	0.42
C18:1	ND	23.44
Σ MUFA	**22.52 ± 1.28**	**23.86**
C18:2 n-6	45.48 ± 1.15	35.84
C18:3n-6	0.13 ± 0.01	NI
C20:2n-6	2.87 ± 0.20	NI
C20:4n-6 AA	0.31 ± 0.03	NI
Σ (n-6) PUFA	**46.39 ± 1.36**	**35.84**
C18:3n-3	2.87± 0.09	3.63
C20:5n-3 EPA	0.16± 0.01	NI
C22:5n-3	0.21± 0.02	NI
C22:6n-3 DHA	0.31± 0.03	NI
Σ (n-3) PUFA	**3.44± 0.07**	**3.63**
18:2n-6/ 18:3n-3	15:1	9:1
C22:2	NI	0.24
Σ PUFA	**49.83**	**39.74**
P/S	1.82	1.09

Note: NI: Not Identified; ND: Not Determined; SFA: Saturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; PUFA: Polyunsaturated Fatty Acids; AA: Arachidonic Acid; P/S: Polyunsaturated/Saturated. Σ (n-3) PUFA: Sum of all the linolenic acid series; P/S: Σ PUFA to Σ SFA ratio. [1]Data obtained from the analysis done at the Physiology and Pharmacology Laboratory of *Universidade Federal de Pernambuco*.
Values expressed as percentages.

already begun by 2008 and the results of the said survey were only published by the *Instituto Brasileiro de Geografia e Estatística* (IBGE) in 2010. Since the present study is linked to a doctoral thesis, it would not be viable to remake the diet and restart the experiments.

Twenty-eight percent of the energy of the POF diet came from fats, 14% from proteins (9% animal protein and 5% plant protein) and 58% from carbohydrates. The centesimal macronutrient composition (g/100g of feed) was 12.6g of fats, 14.5g of proteins, 66.9g of carbohydrates (14.1g of simple carbohydrates) and 2.0g of fiber. The energy density was 4.4kcal/g. Meanwhile, 11% of the energy of the commercial diet came from fats, 26% from proteins and 63% from carbohydrates. The centesimal macronutrient composition (g/100g of feed) of the commercial diet was 4.2g of fats, 23.3g of proteins, 51.8g of carbohydrates and 5.0g of fiber. The energy density was 3.6kcal/g. The POF diet provides 17% more calories from fats and 12% less calories from proteins than the standard diet. The qualitative and quantitative composition of the diets was determined at the LEAAL of the UFPE Departament of Nutrition by the following methods: protein by the Association of Analytical Communities (AOAC) method 991.20 (1998) and fats by the AOAC method 963.15 (1998). Fiber content was calculated by consulting food composition databases and nutrient facts labels. Carbohydrates were obtained by difference and the total energy content was calculated.

According to the literature, the commercial diets used in the bioterium, such as Labina®, are based on the National Research Council (NRC/USA) and National Institutes of Health recommendations. This commercial chow does not reveal its formula. It only lists the basic composition on the packaging, having fishmeal as the protein source, a vitamin and mineral supplement, and an important proportion of bran. The feed may contain calcium carbonate, soybean meal, wheat bran, alfalfa meal, dicalcium phosphate, cornmeal, crude soybean oil and sodium chloride, among others, at the manufacturer's discretion.

Dam's performance

The dams' weights were measured weekly on pregnancy and lactation days 1, 7, 14 and 21. Their body weights were determined by a digital electronic scale of the brand Marte, model S-4000, with 4kg capacity and 0.01g accuracy.

The two groups received daily 30-40g of feed pellets during pregnancy and 40-80g during lactation. Weekly food intake was determined by the equation FC=FO-R, where Consumed Food (FC) is the amount of food consumed per week, Food Offer (FO) is the amount of food given to the animals in grams and Reject (R) is the amount of leftover food in grams. The energy, fat, protein, carbohydrate and fiber intakes were then calculated by multiplying the total intake of each dam in grams by the centesimal composition of each nutrient in the relevant food and dividing by 100. Weekly food intake was assessed for the 3 weeks of pregnancy and 3 weeks of lactation, even though the pups start eating fourteen days after birth, despite suckling[22]. The daily intake of each dam was given by dividing the total amount of food consumed during the 3 weeks of pregnancy by 21 and during the 3 weeks of lactation by 21.

Once the food intake was determined, it was possible to calculate the Weight Gain Coefficient per Energy Intake (WGCEI). WGCEI was determined weekly during pregnancy and lactation and calculated for each group according to the equation WGCEI=(WW-BW)/TEV, where Weekly Weight (WW) is the weekly weight of the animal in grams, Body Weight (BW) is the baseline weight of the animal in grams and Total Energy Value (TEV) is the total energy content of the food in calories[23]. The WGCEI were expressed as percentages.

Indicators of the physical and reflex developments

Physical growth and the development of the reflexes and some physical characteristics were assessed daily from the first to the twenty-first day of lactation. The measurements were done by a digital caliper of the brand Starrett, with an accuracy of 0.01mm. The following measurements were taken: tail length by gently extending the tail of the animal and measuring it from base to tip; longitudinal body axis by gently laying the animal on a flat surface, marking the spots that coincided with the nose and base of the tail and measuring the distance between the two marks with a digital caliper; Skull Laterolateral Axis (SLLA), represented by an imaginary line joining the midpoints of the two pinnae perpendicular to the longitudinal axis of the skull, by holding the animal with one hand with its head between the thumb and forefinger, and measuring the SLLA with a caliper; Skull Anteroposterior Axis (SAPA), represented by a line going from the tip of the nose to an imaginary line running tangent to the posterior ends of the pinnae, by holding the animal as mentioned above and measuring the SAPA with a caliper.

The reflex responses were determined as recommended by Fox, 1965[24]. The day of the full reflex response to a given stimulus was taken down. The day of the full reflex response was considered the first of three consecutive days that the reflex was fully present. The tests were done away from the dams, between 8 and 10 a.m., by the same researcher. The pups had a time limit of 10 seconds to display the reflex[25].

The following physical characteristics were taken down: unfolding of the external ear, ear opening and eye opening.

The following reflexes were investigated: righting - when a pup is placed on its back, it immediately turns over to rest in the normal position with all four feet on the ground; placing response - when a pup is suspended by the tail and lowered so that the vibrissae make contact with a solid object (table), the head is raised and the forelimbs are extended to grasp the object; cliff avoidance - when a pup is placed on the edge of a board with nose and feet forced just over the edge, it shows withdrawal of head and both forefeet from edge and attempts to walk away from it; negative geotaxis - when a pup is placed on a 45° slope (34.0x24.0cm board covered with non-slip crepe paper) with its head pointing down the incline, it turns around and crawls up the slope; aerial righting - when a pup is held by the four paws, upside down, from a height of 30.0cm and released over a 30.0x12.0cm synthetic foam bed, it rotates its body and lands on all fours; and acoustic startle response - when a loud, sharp noise using a metal rod hitting a metal cup (4.5cm diameter and 6.0cm high) is done approximately 10.0cm away from a pup, it startles and withdraws into a crouching position. The dams were sacrificed at the twenty-first day of lactation and the litters were followed for future adulthood studies.

Statistical treatment

The results are expressed as mean standard deviation or median and interquartile ranges (P_{25}-P_{75}), and the number of animals is shown in parenthesis. The normality of all data was tested by the Kolmogorov-Smirnov test. The groups were compared by the Student's t-test or Mann-Whitney test for two samples and two-way Analysis of Variance (Anova) for three or more samples, according to normality and variance, followed by the Bonferroni correction when significant differences were found. The significance level for all tests was set at 5% ($p<0.05$). The data were treated by the software SigmaStat 3.5 (Systat Software, Inc.) and the graphs created by the software Prisma 4® (GraphPad Software Inc., La Jolla, CA, USA).

RESULTS

The baseline weights of the dams of the two groups did not differ (CG=221.56±26.53g;

POFG=242.97±18.19g, p=0.113). The POF diet increased pregnancy duration (CG=21.00±0.00 days; POFG=21.57±0.55 days, p=0.025) but not the amount of weight gained by the dams (CG=350.17±42,87g; POFG=322.54±23.85g, p=0.170) or litter size or weight on the first day of life (24 hours after delivery).

On the other hand, POF diet during lactation promoted greater weight loss in the dams (CG=27.92±18.47g; POFG=-15.66±16.90g, p=0.002) and, consequently, lower final weight at weaning (POFG 16% lighter than CG). The pups of the POFG group also gained less weight during the lactation period (CG=45.02±4.02g; POFG=33.13±2.87g, $p\leq0.001$), roughly 26% less than the controls, and gained 0.56g less per day than the CG (CG=2.14±0.19g/day; POFG=1.58±0.14g/day, $p\leq0.001$) (Table 1).

Other observations regarding the POFG include lower intakes of food, energy, proteins, carbohydrates and fibers and higher intake of fibers during pregnancy and lactation (Table 2). However, these differences were even greater during lactation.

The energy and food intake of the POFG dams was approximately 25 and 30% lower than those of the CG, respectively. This represented a decrease of 56% in protein intake (CG=44.82±7.71g; POFG=101.44±12.50g, $p\leq0.001$) and of 72% in fiber intake (CG=22.05±2.72g; POFG=6.35±1.09g, $p\leq0.001$) (Table 2). On the other hand, the fat intake of the POFG during pregnancy was two times higher than that of the CG (CG=18.70±2.30g; POFG=39.05±6.72g, $p\leq0.001$). The daily fat intake of the POFG dams was 1.86±0.32g/day and of the CG dams, 0.89±0.11g/day (Table 2).

During lactation, the food and energy intakes of the POFG dams were approximately 55% of those of the CG dams. This represented a 71% lower protein intake (CG=133.33±17.39g; POFG=38.45±3.49g, $p\leq0.001$) (Table 2). This low intake decreased the amount of protein consumed daily by the POFG dams considerably (CG=6.35±0.83g/day; POFG=1.83±0.14g/day, $p\leq0.001$) (Table 2). On the other hand, total and daily fat intakes remained high in the POFG because of the higher fat content of the POF diet. During lactation, the POFG dams consumed

Table 1. Effects of the experimental Family Budget Survey (POF) diet on dam's pregnancy, lactation and reproductive performance, and offspring development. *Recife* (PE), Brazil. 2011.

Reproductive performance	Diet groups[1]		p
	CG (n=6)	POFG (n=6)	
Pregnancy			
Pregnancy duration, days	21.00 ± 0.00	21.57 ± 0.55*	0.025
Number of pups, n	10.40 ± 1.50	10.43 ± 2.07	0.980
Baseline body weight, g	221.56 ± 26.53	242.97 ± 18.19	0.113
Final body weight, g	350.17 ± 42.87	322.54 ± 23.85	0.170
Weight gained during pregnancy, g	66.35 ± 39.09	79.57 ± 20.55	0.451
Lactation			
Baseline body weight, g	264.85 ± 25.58	262.39 ± 20.74	0.851
Final body weight, g	292.77 ± 21.47	246.72 ± 21.00*	0.002
Weight change during lactation, g	27.92 ± 18.47	-15.66 ± 16.9*	0.002
Offspring weight after 24h[2], g	58.44 ± 8.17	60.69 ± 9.94	0.719
Offspring body weight gain[3], g	45.02 ± 4.02	33.13 ± 2.87*	≤0.001
Offspring body weight gain[3], %	612.90 ± 41.10	496.00 ± 68.30*	≤0.001
Offspring daily body weight gain[3], g	2.14 ± 0.19	1.58 ± 0.14*	≤0.001

Note: Values expressed as mean ± Standard Deviation or median (P_{25}-P_{75}), n=6-7. *Differences according to the Student's t test or Mann-Whitney test, $p\leq0.05$; [1]CG rats in the Control Group fed commercial chow; POFG: rats in the experimental Group fed Family Budget Survey diet; [2]Body weight of the offspring (males and females) 24 hours after birth; [3]values regarding the offspring's first 21 days (males), n=11-14.

roughly 1.4 times more fat than the CG dams (CG=24.58±3.21g; POFG=33.50±3.04g, $p \leq 0.001$) (Table 2), with daily fat intakes of CG=1.17±0.15g/day and POFG=1.59±0.14g/day, $p \leq 0.001$ (Table 2).

When the energy coefficient (weight gain in grams divided by energy intake in kcal) was assessed (Table 2), the POFG energy coefficients during pregnancy and lactation were significantly lower than those of the CG. However, during lactation the mean weight variation per calorie consumed was negative (CG=1.37±0.92; POFG=-1.35±1.47%, $p \leq 0.001$). These values are coherent with the final dam weights and reflect

Table 2. Total and daily food, energy and nutrient intakes of the dams during pregnancy and lactation according to diet. *Recife* (PE), Brazil, 2011.

	Diet groups[1]		
Pregnancy	CG (n=6)	POFG (n=6)	*p*
	Mean ± SD	Mean ± SD	
Total food intake, g	441.03 ± 54.36	309.94 ± 53.32**	≤0.001
Daily food intake, g	21.00 ± 2.59	14.76 ± 2.54**	≤0.001
Total energy intake, Kcal	1587.70 ± 195.71	1358.14 ± 233.65*	0.084
Daily energy intake, Kcal	75.00 ± 9.32	64.67 ± 11.13*	≤0.05
Food intake 1° week, g	129.55 ± 38.31	98.09 ± 21.84*	≤0.05
Food intake 2° week, g	114.42 ± 39.53	95.30 ± 25.90	0.22
Food intake 3° week, g	197.05 ± 19.12	116.55 ± 13.05*	≤0.05
WGCEI[2], g/%	8.22 ± 1.80	5.97 ± 1.66*	0.039
Protein intake, g	101.44 ± 12.50	44.82 ± 7.71**	≤0.001
Daily protein intake, g	4.83 ± 0.59	2.13 ± 0.37**	≤0.001
Carbohydrate intake, g	250.55 ± 30.88	201.15 ± 34.60*	0.021
Daily carbohydrate intake, g	11.93 ± 1.47	9.58 ± 1.65*	≤0.05
Fat intake, g	18.70 ± 2.30	39.05 ± 6.72**	≤0.001
Daily fat intake, g	0.89 ± 0.11	1.86 ± 0.32**	≤0.001
Fiber intake, g	22.05 ± 2.72	6.35 ± 1.09**	≤0.001
Daily fiber intake, g	1.05 ± 0.13	0.30 ± 0.05**	≤0.001
Lactation			
Total food intake, g	579.71 ± 75.60	265.89 ± 24.17**	≤0.001
Daily food intake, g	27.60 ± 3.60	12.66 ± 1.15**	≤0.001
Total energy intake, Kcal	2086.96 ± 272.18	1165.14 ± 105.91**	≤0.001
Daily energy intake, Kcal	99.38 ± 12.96	55.48 ± 5.04**	≤0.001
Food intake 1° week, g	187.47 ± 48.05	99.39 ± 17.66***	≤0.0001
Food intake 2° week, g	392.24 ± 31.59	166.51 ± 33.94***	≤0.0001
Food intake 3° week, g	467.55 ± 41.76	221.24 ± 37.47***	≤0.0001
WGCEI[2,a], g/%	1.37 ± 0.92	-1.35 ± 1.47**	≤0.001
Protein intake, g	133.33 ± 17.39	38.45 ± 3.49**	≤0.001
Daily protein intake, g	6.35 ± 0.83	1.83 ± 0.17**	≤0.001
Carbohydrate intake, g	329.33 ± 42.95	172.56 ± 15.69**	≤0.001
Daily carbohydrate intake, g	15.68 ± 2.04	8.22 ± 0.75**	≤0.001
Fat intake, g	24.58 ± 3.21	33.50 ± 3.04**	≤0.001
Daily fat intake, g	1.17 ± 0.15	1.59 ± 0.14**	≤0.001
Fiber intake, g	28.99 ± 3.78	5.45 ± 0.49**	≤0.001
Daily fiber intake, g	1.38 ± 0.18	0.26 ± 0.024**	≤0.001

Note: Values expressed as mean ± Standard Deviation, n=6/group. *Differences according to the Student's *t* test or two-way Repeated Measures Anova (two-way RM Anova) followed by the Bonferroni correction, *$p \leq 0.05$; **$p \leq 0.001$;***≤ 0.0001. [1]CG: rats in the Control Group fed commercial chow; POFG: rats in the experimental group fed *Pesquisa de Orçamento Familiar* diet; [2]WGCEI: Weight gain Coefficient per Energy Intake. [a]WGCEI: Values expressed as percentages (%).

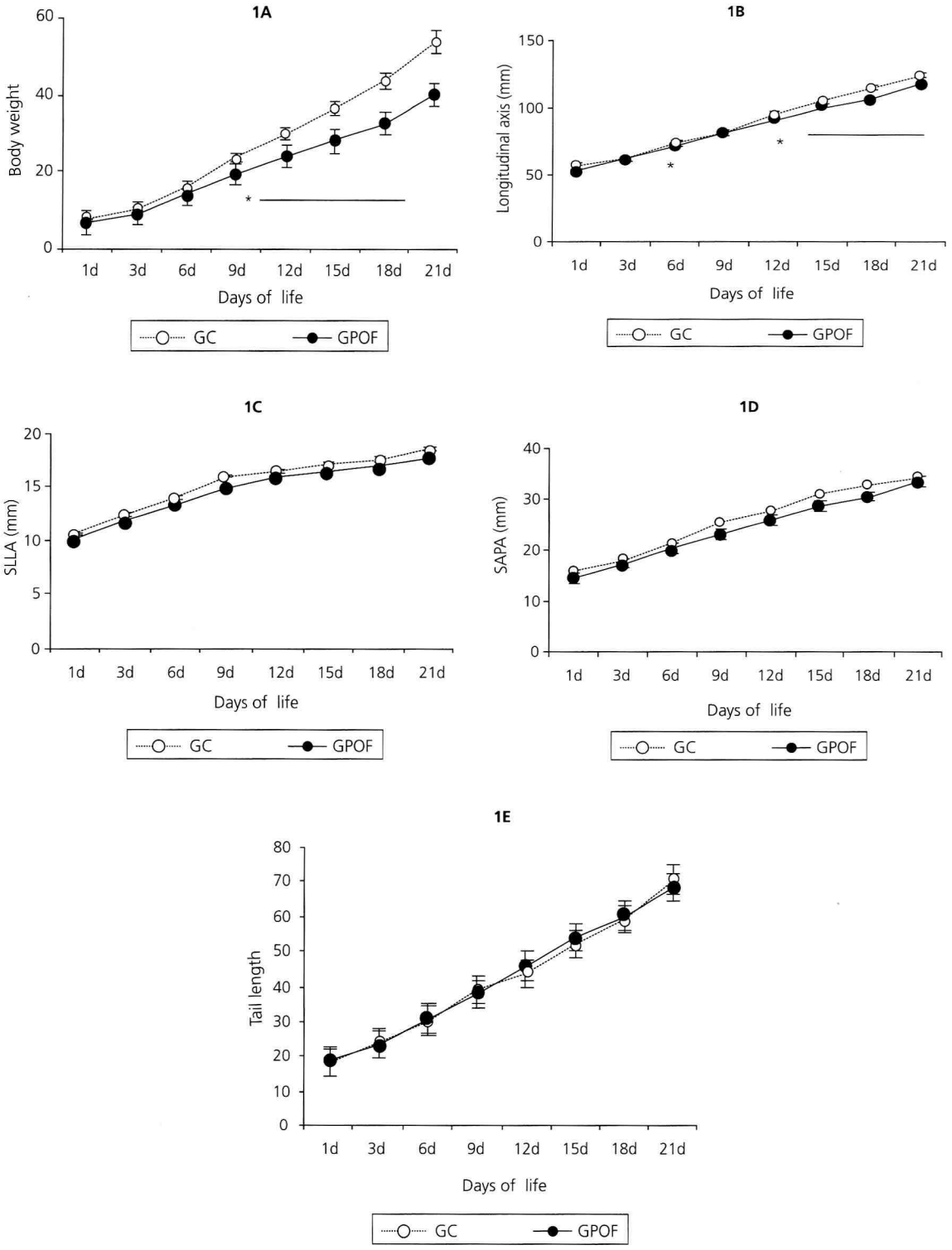

Figure 1. Offspring growth (body weight (1A) longitudinal body axis (1B) skull laterolateral axis (1C), skull anteroposterior axis (1D) and tail length (1E) according to the diets consumed by the dams during pregnancy and lactation. *Recife* (PE), 2011.

Note: *$p \leq 0.01$. Values expressed as mean ± Standard Deviation, n=11-14. Differences according to two-way Repeated Measures Analysis of Variance (two-way RM Anova) followed by the Bonferroni correction. SLLA: Skull Laterolateral Axis; SAPA: Skull Anteroposterior Axis. CG: rats in the Control Group fed commercial chow; POFG: rats in the experimental group fed Family Budget Survey diet.

a lower efficiency of the POF diet to increase or maintain weight per kilocalorie consumed. Table 2 shows the lower daily food intakes of the POFG dams during pregnancy and lactation.

The POFG dams consumed less food during the first (CG=129.55±38.31g; POFG=98.09±21.84g, p=0.014) and last (CG=197.05±19.12g; POFG=116.55±13.05g, p=0.014) weeks of pregnancy (Table 2). However, they consumed less food during the entire lactation period (Table 2). Food intake by the POFG dams was roughly 30% lower during pregnancy and 50% lower during lactation. During pregnancy, intragroup assessment showed that the CG dams consumed a similar amount of food in the first and second weeks and significantly more in the third week, while the POF dams consumed a similar amount of food during the entire pregnancy. However, during lactation, the food intake of both groups increased weekly. However, this increase was less pronounced in the POFG.

The growth of the pups was determined by measuring body weight, nose-to-anal length, tail length and skull axes. From the ninth day of life onward, the POFG pups' weights were smaller than those of the CG pups (CG=23.00±3.00g; POFG=19.80±1.64g, p≤0,001), and this trend continued until weaning (CG=52.38±4.49g; POFG=39.88±2.78g, p≤0.0001) (Figure 1A). The nose-to-anus lengths of the POFG pups were smaller on the sixth day of life (CG=74.70±3.20mm; POFG=71.08±1.92mm, p≤0.01), and from the twelfth day onward (CG=89.76±1.40mm; POFG=94.52±3.21mm, p≤0,001) (Figure 1B). The SLLA of the POFG pups were 7-10% smaller than those of the CG pups from birth but the differences w'ere not significant (Figures 1C). No difference also found to skull anteroposterior axis (Figure 1D) or tail length (Figure 1E). During this period, the tail length reflects the development of the nervous system.

With respect to physical and reflex development, the POFG pups developed the placing response reflex [CG=12.00 (9.00-15.00 days); POFG=9.50 (9.00-14.00 days), p=0.023] and aerial righting reflex [CG=18.00 (17.00-20.00 days); POFG=16.00 (13.00-18.00 days), p≤0.001] before the CG pups. Their ears also unfolded before those of the CG pups [GG=3.00 (3.00-3.00 days); POFG=2.00 (2.00-3.00 days), p=0.03] (Table 3).

Table 3. Postnatal reflex development and physical characteristics of the offspring of dams fed a commercial diet or the experimental Family Budget Survey (POF) diet during pregnancy and lactation[1]. *Recife* (PE), Brazil, 2011.

Reflexes	Diet groups[2]		*p*
	CG (n=11)	POFG (n=14)	
	Median (P_{25}-P_{75})	Median (P_{25}-P_{75})	
	day		
Righting	5.00 (4.00-8.00)	6.50 (4.00-9.00)	0.27
Placing response	12.00 (9.00-15.00)	9.50 (9.00-14.00)*	0.02
Cliff avoidance	9.00 (7.00-10.00)	7.00 (6.00-9.00)	0.26
Negative geotaxis	12.00 (12.00-13.75)	13.50 (13.00-14.00)	0.12
Acoustic startle	12.00 (12.00-12.00)	12.00 (12.00-13.00)	0.31
Aerial righting	18.00 (17.00-20.00)	16.00 (13.00-18.00)*	<0.001
Physical characteristics	*day*		
Unfolding of the external ear	3.00 (3.00-3.00)	2.00 (2.00-3.00)*	0.03
Ear opening	12.00 (12.00-12.00)	12.50 (12.00-13.00)	0.13
Eye opening	15.00 (15.00-15.00)	14.00 (13.00-15.00)	0.08

Note: Differences according to the Mann-Whitney test, p≤0.05. [1]Values expressed as median (P_{25}-P_{75}), n=11-14/group. [2]CG: Control Group fed standart chow dut; POFG: experimental group fed Family Budget Survey diet; day: first day in which the reflexes and physical characteristics occurred.

DISCUSSION

The present study found that when female rats consume the POF diet during pregnancy and lactation, their reproductive performance and the growth and development of their pups are affected. On the other hand, the ears of the pups of these dams unfolded sooner than those of the control group and some of their reflexes also developed sooner.

The main characteristics of the POF diet is high fat content, three times higher than that of the control diet, a commercial diet for rodents, and low protein content, roughly half that of the control diet. Its macronutrient composition is similar to those of most cafeteria diets discussed in the literature. Cafeteria diets also have high-fat contents and usually low-protein contents, and are routinely used for inducing obesity in rodents. Generally, cafeteria diets have a negative impact on maternal performances[16,17] since mixing commercial chows with high-fat foods reduces the fiber, micronutrient and protein contents, preventing the mixture from meeting the animals' requirements during reproduction and growth[25]. The delayed physical growth of the offspring and hazards to the reproductive process of the dams observed in the present study are similar to those obtained with cafeteria diets.

Like cafeteria diets, the POF diet has inadequate protein content for the growth and development of rats. Protein seems to be more critical than energy for reproduction[1]. Proper amounts of protein in chows with high-fat content increases pup growth and does not change serum protein levels[15], which indicate protein adequacy. Studies have found that high-fat and low-protein diets increased duration of pregnancy and reduced pup survival[16,17,25]. The present study also found an increased duration of pregnancy in the POFG, but litter size or pup survival was unaffected.

Rats on the POF diet also consumed less food, which further decreased their protein and energy intakes during pregnancy and lactation. However, since the POF diet was more energy-dense, their fat intake remained higher than that of the control group. A similar result was found by Brito *et al.*,[9] who reported that dams fed a high-fat (24.2%) and low protein (7.0%) diet consumed less food during pregnancy, resulting in 82.0% less protein intake and 23.0% less energy intake, but fat intake was three times higher.

According to the literature, rats usually experience polyphagia (excess hunger) at the end of pregnancy and during the lactation period. The present study found that the POFG presented a lower food intake during the first week of pregnancy and even lower on the third week of pregnancy, when the rats should be hungrier, and during the entire lactation period, demonstrating absence of polyphagia during the entire study period. The absence of a higher food intake by the POFG may be due to the satiety produced by the high-fat content of the diet and/or their low protein intake.

Both high fat[25] and small protein[5] intakes are associated with low food intake. Polyphagia is not seen in pregnant and lactating rats fed the cafeteria diet. These rats usually consume less food and lose more weight during lactation. Intense weight loss stems from greater mobilization of the adipose tissues during lactation, that is, of the maternal reserves stored during pregnancy[26], fact observed in the POFG dams.

Pups from dams fed cafeteria diets are usually lighter[26] and do not suckle well. Less suckling stimulus reduces the amount of milk produced, reducing appetite, since suckling stimulus promotes milk production and increases appetite during lactation[5]. Additionally, during lactation prolactin does not act only on the mammary gland to promote milk production; it also promotes leptin resistance and increases food intake. Yet, at the end of the lactation period, low serum insulin and leptin induce catabolism, characterized by the release of fatty acids for milk production. Low serum insulin and leptin levels

promote polyphagia, and the prolactin-induced leptin resistance helps to increase hunger further. This way, it is likely that physiological mechanisms responsible for the delayed growth of the POFG pups are similar to the ones listed above.

Low-protein diets reduce serum prolactin by 70%, evidenced by less suckling and milk production, which in turn does not promote leptin resistance, characteristic of this phase[27]. Shaw *et al.*[25] stated that the third week of pregnancy is characterized by continuous hyperinsulinemia and insulin resistance. Accordingly, the intake of high-fat diets (35%) has a smaller impact on serum insulin during pregnancy and greater during lactation, while the opposite is observed in control rats. This peculiar phenomenon partly explains the food intake changes presented by rats consuming low-protein and/or high-fat diets. Moreover, fats provide per gram more than double the amount of energy provided by carbohydrates and proteins. High fat intake may increase the levels of peptides that inhibit appetite, such as cholecystokinin, promoting greater satiety and smaller food intake. This quantitative reduction balances energy intake[28] but reduces the intake of other nutrients. According to Shaw *et al.*[25], the high-fat (35%), high-energy diet reduced the food intake of the dams significantly. Guo & Jen[29] also observed that dams on a high-fat diet (40%) presented low food and energy intakes. Together, these facts found the findings of the present study regarding the POF diet.

Although the POFG dams consumed less food and energy during pregnancy, their weight gains were not significantly different from those of the control group. During pregnancy the body uses different energy substrates to meet its requirements. More adipose tissue is mobilized to increase the availability of glucose to the fetus[30]. Therefore, the greater fat content of the POF diet may have contributed to greater lipogenesis, facilitating the storage of triglycerides in the maternal reserves and so promoting similar weight gain to that of the controls.

Lipids are known to have greater metabolic efficiency than other macronutrients, which promotes greater storage and weight gain[28]. Although weight gain is caused by an unbalance between energy intake and expenditure, the macronutrient composition of the diet has an important impact on body weight regardless of energy intake[28]. Diets with greater amounts of energy coming from fats are capable of promoting weight gain even when food intake is smaller and energy intake is smaller or equal[28].

The balanced body weight seen during pregnancy did not occur during lactation. The significant decrease in food and energy intakes caused the POFG dams to lose a considerable amount of weight. Brito *et al.* (2006)[9] also observed that dams fed a high-fat (24.2%), low-protein (7.0%) diet had lost 14.0% more weight by the end of the lactation period than the controls. During lactation, the negative weight gain coefficient per energy intake of the POFG is in agreement with their greater weight loss. Hence, even though the POF diet had more fat and energy density than the commercial chow, food intake during lactation was low enough to deplete the POF dams' reserves. During lactation, consumption of high-fat, low-protein diets seems to increase serum triiodothyronine by 74.0% and decrease thyroid-stimulating hormone by 26.0%. These changes induce thyroid hyperfunction, promoting greater iodine uptake and $T3^9$ synthesis, which in turn promotes greater energy expenditure and weight loss.

The low food and energy intakes and intense weight loss presented by the POFG dams impaired the growth and development of their pups. POFG pups gained less weight and body length during the first 21 days of life. Maternal low protein intake during pregnancy and lactation impairs pups' growth permanently, causing irreversible changes in organ size and function, especially the liver, and in body composition and growth hormone secretion[31]. High-fat, low-protein diets seem to impair pup growth[11] by reducing Growth Hormone expression in the pups, impairing weight and length gain[7].

In addition, food intake during lactation has a direct impact on the availability of nutrients for milk synthesis. In turn, milk availability has a direct impact on pup growth[26,32]. Pups from dams fed a high-fat diet (20%) with adequate protein content are significantly heavier than controls on the sixth day of life, and the difference in weight is even greater by day nine[32]. These dams not only produced more milk, but their milk also presented higher fat, protein and energy contents. Together, these factors probably made the pups grow more[33].

The lower gain in body weight and length of the POFG pups likely reflects the low protein and energy intakes of the POFG dams. Meanwhile, the greater fat content of the POF diet may have contributed to the normal development of the nervous system, not impacting skull growth. This fact may stem from the moderate increase in dietary fat. According to Gadja *et al.*[14], diets with as much as 30% of their energy coming from fats are appropriate for rats. On the other hand, when more than 50% of the dietary energy comes from fats, typical of ketogenic diets, the effect of low protein intake is marked, causing more stunting[11]. Also, low dietary protein increases the fat content of milk from the fourth day of lactation[6]. High-fat diets increase the fat content and energy density of the milk, causing greater satiety and, therefore, less intake[32]. These facts may explain to a certain degree the smaller skull growth seen in the POFG pups, but the difference was not significant.

The laterolateral and anteroposterior axes of the skull are correlated with regions called neurocranium and viscerocranium, respectively. The viscerocranium is used for feeding, is more subject to muscle overload and seems to be more vulnerable to epigenetic factors, such as low protein intake. The neurocranium is the part of the skull that houses the brain. Its development is mainly influenced by brain growth. At birth, this part has already completed much of its growth. Thus, after birth the viscerocranium grows faster than the neurocranium, in accordance with the functional demand[4]. The viscerocranium of rats fed a low-protein diet (4%) grow less, probably because of faster growth[4].

The results of the present study show that the anteroposterior axis of the skulls of POFG pups grew approximately 7-10% less than that of controls. Their neurocrania also grew 6% less but the difference was not significant. These findings are in agreement with those of Miller & German[4] who reported the vulnerability of this axis to a low-protein diet during perinatal life. However, the differences found in Miller & German's[4] study stemmed from a very low-protein diet (4%) with normal fat content. So the axes may have been preserved in the present study because the POF diet was not extremely low in protein and was high in fats.

At the same time, some developmental milestones of the POFG pups developed sooner, namely the reflexes placing response and aerial righting, and unfolding of the external ear. According to Torres *et al.*[10], moderate protein restriction (10%) reduces the amount of Arachidonic Acid and Docosahexaenoic Acid (DHA) in the dam's liver, along with the enzymes that elongate and desaturate essential fatty acids, resulting in lower fat content in the fetal brain. Marin *et al.*[33] then showed that these events are minimized when dietary fat consists of soybean oil, even if protein content is below 5%. This is probably due to the fact that soybean oil has higher alpha-linolenic (n-3) and linoleic (n-6) contents, at a ratio of 1:6, respectively[33].

On the contrary, low-protein (8%), high-fat diets (ketogenic) with low essential fatty acid contents delay the development of reflexes and physical milestones in pups[11]. The early development of the POFG pup reflexes seen in the present study may stem from the not-so-low protein content (14%) of the diet, adequate n-6 to n-3 ratio, and moderate, not high, fat content according to Gadja's *et al.*[14] classification.

Adequate essential fatty acid availability favors brain development[3,11], which accumulate in the fetal brain during the last week of

intrauterine life[11]. DHA peaks on the twentieth day of intrauterine life. Therefore, when pups are born before the twenty-first day of intrauterine life, the fetal brain content of these fatty acids is lower. Other factors that may reduce brain Polyunsaturade Fatty Acids (PUFA) levels is low n-3 intake, since these fatty acids are usually less abundant in foods than n-6, and inappropriate n-6 to n-3 intake ratio[12].

The Family Budget Survey diet does not seem to have an unfavorable n-3 content or n-3 to n-6 ratio. When n-3 is low, these acids are replaced by n-6 in cell compartments, causing a quantitative, not qualitative, compensation. This quantitative deficit is hard to correct once desaturase activity in the liver decreases radically after the eighth day of life and, consequently, the conversion of essential fatty acids into long-chain PUFAs. In addition, essential fatty acid requirement varies from organ to organ and with tissue nature[12]. Thence, early and adequate availability of essential fatty acids and preformed long-chain PUFAs to the developing brain is crucial to avoid deficits during the critical development period of the nervous system.

The sudden reduction in desaturase levels in the first days of life may also decrease the synthesis of long-chain PUFA that use linolenic and linoleic acids as precursors[12]. The Polyunsaturated to Saturated fatty acid (P/S) ratio is equally important for enzyme activity; the acceptable ratio is 1:6[12].

The Family Budget Survey diet has an n-6 to n-3 ratio close to the recommendations for proper PUFA levels in the pups' brains[12]. Medium- and long-term adverse effects that may stem from the POF diet may be due to its total saturated fat content or its P/S ratio, since its P/S ratio is far from the accepted ratio.

With respect to the physical milestones, ear duct and eye development seem to be more susceptible to dietary changes, especially unbalanced fat intake, which impacts negatively the myelination of the sensory systems[11,13]. Hearing develops after birth and is complete by the fourth week of life[13]. Timely development of this function seems to depend on the dietary availability of polyunsaturated fatty acids, such as arachidonic and docosahexaenoic acids, which accumulate in the developing brain. Appropriate fatty acid levels in the POF diet may have prevented deleterious effects on the physical development of the pups or even accelerated them, since the auditory and visual systems seem to be more sensitive to dietary fat unbalances.

Not only inadequate nutrients but also excess nutrients may impair growth and/or development. Intake of a high-fish oil diet (high n-3 content) by dams increased the DHA levels in the brains of the pups but delayed their auditory startle response and auditory brainstem conduction times[13]. It seems that high-omega-3 diets reduce myelination-related enzyme activity, thereby impairing auditory system myelination.

In conclusion, the present results suggest that the POF diet is detrimental to pup growth but according to reflex development, brain growth was less affected. The results stem from the moderate fat content, appropriate essential fatty acid content and low protein content of the diet for the critical growth phase of the pups. The results may have also been affected by the low food intake of the POFG. Once the protein content of the POF diet is corrected, macronutrient intakes will not be affected during pregnancy and lactation, and body growth will not be impaired.

The authors emphasize that the present results cannot be extrapolated to human beings because of the distinct metabolic rates and nutritional requirements of both species. Additionally, the POF diet is based on a food purchasing pattern, not on a food survey that distinguishes the different food patterns associated with different life phases.

ACKNOWLEDGMENTS

We thank *Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco* (FACEP) for sponsoring the study, Lúcia Pires for helping with the

statistical analyses, Food Experimentation and Analysis Laboratory, Professor Dr. Belmira Lara Silveira Andrade da Costa from the *Universidade Federal de Pernambuco* Laboratory of Physiology and Pharmacology and Dr. Edeones Tenório França, veterinarian from the *Universidade Federal de Pernambuco* Department of Nutrition bioterium.

CONTRIBUTORS

MF CARVALHO participated in the development of the practical research, data collection and analysis and article preparation. MKME COSTA participated in the development of the practical research and data collection. GS MUNIZ helped to prepare the article and analyze data. RM Castro helped in the final revision of the article. E NASCIMENTO planned the study and helped in the preparation of the article, supervising the writing and data analysis.

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Received on: 17/4/2012
Final version on: 17/10/2012
Approved on: 13/11/2012

Factors associated with breakfasting in users of a public health service

Fatores associados à realização do café da manhã em serviço público de saúde

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ABSTRACT

Objective

This study identified the sociodemographic, lifestyle, dietary and anthropometric factors of users of a public health promotion service who have breakfast regularly.

Methods

This cross-sectional study included all users aged 20 years or more who joined the service between March 2007 and December 2010. Their socioeconomic and anthropometric data, dietary habits and health status were investigated. Statistical treatment included the Chi-square, Mann-Whitney, Fisher's exact and Student's *t* tests and Poisson regression analysis ($p<0.05$).

Results

Most of the participants (87.1%, n=528) breakfasted often, especially those aged 48.5 years or more ($p=0.041$). Poisson regression analysis showed association between breakfasting often and not smoking (PR=1.45, 95%CI: 1.10-1.91), having a greater number of daily meals (PR=1.15, 95%CI: 1.06-1.25), appropriate intake of deep-fried foods (PR=1.12, 95%CI: 1.01-1.25), lower fat intake (PR=0.78, 95%CI: 0.68-0.89) and smaller prevalence of excess weight (PR=0.85, 95%CI: 0.78-0.92).

Conclusion

The positive relationship found between breakfasting often and not smoking, appropriate food and nutrient intakes and a healthier body weight shows the need of emphasizing this meal in health services as a simple and doable health promotion strategy that helps to prevent and control chronic diseases.

Indexing terms: Health promotion. Lifestyle. Nutrition. Obesity. Public health.

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Apoio: Fundação de Amparo à Pesquisa do Estado de Minas Gerais, Registro CDS APQ 0376- 408/07.

RESUMO

Objetivo

Identificar os fatores sociodemográficos, de estilo de vida, dietéticos e antropométricos relacionados à realização do café da manhã entre os ingressos de serviço público de Promoção à Saúde.

Métodos

Estudo transversal com todos os usuários, com 20 anos ou mais, que ingressaram no serviço no período de março de 2007 a dezembro de 2010. Investigaram-se dados socioeconômicos, hábitos alimentares, perfil antropométrico e de saúde. Realizaram-se os testes Qui-quadrado, Mann Whitney, Exato de Fisher e t de Student, *e análise de regressão de Poisson (p<0,05).*

Resultados

Dos participantes (n=528), 87,1% realizavam frequentemente o café da manhã, sendo mais prevalente entre aqueles com 48,5 anos ou mais (p=0,041). A análise de regressão de Poisson revelou associação entre a realização frequente do café da manhã com o hábito de não fumar (RP=1,45; IC95%:1,10-1,91); maior número de refeições diárias (RP=1,15; IC95%:1,06-1,25); consumo adequado de frituras (RP=1,12; IC95%:1,01-1,25); menor ingestão de lipídios na dieta (RP=0,78; IC95%:0,68-0,89) e menor prevalência de excesso de peso (RP=0,85; IC95%:0,78-0,92).

Conclusão

A relação positiva encontrada entre o consumo do café da manhã com o não tabagismo, ingestão adequada de alimentos e nutrientes, e um peso mais saudável, denota a necessidade de se enfatizar esta refeição, enquanto estratégia simples e factível de aconselhamento de promoção da saúde, de forma a contribuir para a prevenção e o controle de doenças crônicas em serviços de saúde.

Termos de indexação: *Promoção da saúde. Estilo de vida. Nutrição. Obesidade. Saúde pública.*

INTRODUCTION

Breakfast, defined as the first meal of the day, should respond for 25% of the daily energy intake[1]. However, recent lifestyle changes, lack of time and eating away from home have promoted new eating behaviors that contribute to skipping breakfast[2].

Skipping breakfast has been observed in different life cycles and 14 to 30% of all adults do it[3]. Although the frequency of breakfasting increases with age, it is the most neglected meal among adults when compared with lunch and supper[3,4]. Its nutritional composition has also been affected, being limited to pure coffee or milk and coffee, and bread. Brazilians still habitually consume butter or margarine but the consumption of fruits is rare[5]. Alves & Boog[4] found that 30% of their sample did not breakfast and only 13% had a complete breakfast, that is, one with body-regulating foods such as fruits and calcium sources.

Many factors have been associated with skipping breakfast, such as smoking, consumption of alcoholic beverages, physical inactivity, low education level and being male[6]. Moreover, there is lack of time and hunger, and the desire to diet and lose weight. Skipping breakfast to eat small snacks later may lead to a higher intake of carbohydrates and fats, and consequently, of calories[7].

Individuals who breakfast present a higher intake of healthier foods, such as milk, fruits, vegetables and grains, instead of foods high in calories, fats and sugar[8]. Hence, breakfast has been associated with positive health effects[6,9], such as increased satiety, smaller daily energy intake, better glycemic control[10], lower risk of gaining weight[3,6,7] and visceral fat[9], and lower risk of weight-related comorbidities, such as hypertension, diabetes *Mellitus* and cardiovascular diseases[7,10].

Despite the importance of breakfast to health, there is little information in the Brazilian

literature about this meal, and it is not offered in health services. Nevertheless, according to the country's public policies, primary healthcare is the main location for the development of health-promoting and disease-preventing and - controlling actions[11]. In this sense, the objective of this study was to identify the sociodemographic, lifestyle, dietary and anthropometric factors of users of a public health-promotion service according to breakfasting frequency.

METHODS

A cross-sectional study was done from March 2007 to December 2010 with all users aged 20 years or more of a health-promotion service of *Belo Horizonte, Minas Gerais,* called *Academia da Cidade* (city gym). The city gyms provided regular physical activity and nutritional advice to individuals aged 18 years or more living in city areas of high social vulnerability[12].

The data were collected by a pretested questionnaire[13]. The questionnaire was adapted to the reality of the city gyms. Some questions were changed and some were added, such as questions that investigate the use of medications. The questionnaire was administered by dieticians and trained trainee dieticians and collected sociodemographic data (gender, age, job, number of individuals in household, household income per capita and education level); dietary habits (mastication quality, snacking between meals, drinking while eating main meals, intake of chicken skin and visible fat in meat, per capita intake of salt, vegetable oil and sugar), health profile (reported diseases, perceived body image, use of medications and smoking status), food intake data and anthropometric data[13].

Food intake was investigated by a 24 hour recall (R24) associated with a qualitative Food Frequency Questionnaire (FFQ) with a list of 30 foods covering the last six months[13]. This study selected eleven foods for analysis according to the plausibility reported in the literature[4,5,8]. The consumption of some foods was 100% adequate, so they were excluded from the analysis.

Fruit and vegetable intake adequacies were determined by the World Health Organization (WHO)[14]. The intake adequacies of salt, sugar, oil, water, milk and dairy products, sandwich cookies, sweets, deep-fried foods, sodas and powdered drink mixes were determined by the Food Guide for the Brazilian Population (*Guia Alimentar para a População Brasileira*)[15].

The data collected by the R24 was analyzed by the software Diet Win® Professional version 2.0. Measurements in cooking units were converted to grams using a specific table. Food composition was analyzed by different food composition tables, preparation recipes and food labels, when necessary[13].

The study nutrients were calories, carbohydrates, proteins, fats, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, cholesterol, calcium, iron, zinc, sodium, fibers and vitamins A, D, E, C and B_{12}. Energy and macronutrient intakes were classified as recommended by the Institute of Medicine (IOM)[16] according to gender and age. Micronutrient intakes were classified as inadequate, adequate or excessive according to the IOM recommendations[17] and fatty acid and cholesterol intakes were classified according to the WHO's recommendations[14].

Weight, height, Waist Circumference (WC) and Hip Circumference (HC) were collected as recommended by the WHO[18] for determining nutritional status.

Body mass index was calculated by dividing the weight (kg) by the square of the height (m^2) and classified according to age. For adults, the cut-off points proposed by the WHO[18] were used and for the elderly, those proposed by the Nutrition Screening Initiative[19] were used. For presentation of the data, adults and elderly were classified as underweight, normal weight and excess weight. WC and Waist-to-Hip Ratio (WHR) were classified as recommended by the WHO[20].

Breakfasting, the dependent variable of this study, was assessed by asking the participants how many times a week they breakfasted. For

data analysis, the variable was dichotomized into frequent breakfasting (4 times or more per week) and occasional breakfasting (less than 4 times per week). The reference category was frequent breakfasting.

Statistical analyses included the Chi-square, Mann-Whitney, Fisher's exact and Student's *t* tests. The variables with normal distribution according to the statistical Kolmogorov-Smirnov test were presented as mean and standard deviation and the remainder variables as median, minimums and maximums.

For Poisson regression analysis with robust variance, the response variable was considered frequent breakfasting. The variables with significance smaller than 0.20 or those considered relevant in the study context were tested with the response variable. The dichotomized variables were categorized as 0 and 1 and the other categorical variables were transformed into dummy variables. The variables were adjusted to the model by the backward stepwise method. The Prevalence Ratio (PR) with a Confidence Interval of 95% (95%CI) was used as effect measure. The significance level for all tests was set at 5% ($p<0.05$). The data were treated by the software Stata version 7.0.

This study was approved by the Research Ethics Committees of the *Universidade Federal de Minas Gerais*, under protocol number ETIC 103/2007, and of *Belo Horizonte* City Hall, under protocol number 087/2007. All participants signed a free and informed consent form after being informed about the study.

RESULTS

A total of 528 users participated in the study. Most were women with a mean age of 48.0±13.0 and low per capita income. The prevalence of reported morbidities was high, especially high blood pressure and high cholesterol level (Table 1).

Table 1. Sociodemographic and health characteristics of the users of a health-promotion service of *Belo Horizonte*, according to breakfasting frequency. *Belo Horizonte* (MG), Brazil, 2010.

Variables	Breakfasting frequency			*p* value
	Total (n=528)	Frequent (n=460)	Occasional (n=68)	
Age (years)	48.0±13.0	48.5±12.8	45.0±14.4	0.041[a]
Females (%)	90.7	86.9	91.3	0.229[b]
Monthly per capita income (R$)	333.33 (22.0;2700.00)	333.33 (22.0;2700.00)	340.00 (28.00;2250.00)	0.368[c]
Number of people in household	4.0 (1.0;15.0)	4.0 (1.0;15.0)	3.5 (1.0;6.0)	0.650[c]
Education level				
4 years or less	29.0	28.7	30.9	0.711[b]
5 years or more	71.0	71.3	69.1	
Occupation (%)				
Unemployed	7.2	4.4	7.4	0.695[b]
Retired	14.9	14.7	14.9	
Homemaker	28.8	26.5	29.1	
Other	49.1	54.4	48.4	
Reported diseases (%)				
High blood pressure	48.9	40.7	43.3	0.693[b]
High cholesterol	28.7	28,7	30.0	0.831[b]
High triglycerides	13.6	14.0	10.2	0.416[b]
Diabetes *Mellitus*	8.9	6.3	9.3	0.421[b]
Use of medications (%)	67.4	67.8	64.7	0.617[b]
Smoker (%)	11.0	8.1	28.3	<0.001[b]
Healthy body image (%)	31.4	14.9	29.3	0,006[b]

Note: [a]Student's *t* test; [b]Chi-square test; [c]Mann Whitney test.

Table 2. Dietary habits of users of a health-promotion service of Belo Horizonte, according to breakfasting frequency. *Belo Horizonte* (MG), Brazil, 2010.

Variables (%)	Breakfasting frequency			*p* value
	Total (n=528)	Frequent (n=460)	Occasional (n=68)	
Chews food well	72.8	61.1	47.8	0.037[a]
Consumes beverages during main meals	54.0	52.7	62.7	0.126[a]
Number of meals per day	4.0 (0.0;8.0)	4.0 (2.0;8.0)	3.0 (0.0;7.0)	<0.001[b]
Snacks between meals	50.8	51.9	43.5	0.287[a]
Eats chicken skin	65.5	66.8	55.7	0.088[a]
Eats apparent meat fat	28.2	29.9	17.6	0.071[a]
Appropriate intake				
Salt	58.0	57.1	63.9	0.315[a]
Sugar	24.6	25.1	21.3	0.525[a]
Oil	10.9	11.6	6.2	0.187[a]
Fruits and vegetables	31.0	31.0	31.3	0.969[a]
Water	26.6	24.7	38.8	0.015[a]
Milk and dairy products	8.4	8.9	4.4	0.210[a]
Sandwich cookies	95.0	95.8	89.6	0.027[a]
Sweets	70.4	71.7	61.8	0.094[a]
Deep-fried foods	65.5	68.4	45.6	<0.001[a]
Soda	80.1	80.9	75.0	0.258[a]
Powdered drink mixes	51.6	52.5	45.6	0.286[a]
Weekly intake of alcoholic beverages	18.9	17.4	29.4	0.018[a]

Note: [a]Chi-square test; [b]Mann Whitney test.

Table 3. Nutrient and calorie intake of the users of a health-promotion service of *Belo Horizonte*, according to breakfasting frequency. *Belo Horizonte* (MG), Brazil, 2010.

Variables	Total (n=528)	Breakfasting frequency		*p* value
		Frequent (n=460)	Occasional (n=68)	
Calories (kcal)	1671.0 (324.0;6.254.0)	1676.0 (324.0;5432.0)	1578.0 (519.0;6254.0)	0.227[a]
Carbohydrates (%)	49.8±10.4	50.3±10.0	46.4±12.6	0.004[b]
Proteins (%)	14.0 (2.7;68.5)	13.8 (2.7;68.5)	14.2 (4.7;32.8)	0.633[a]
Lipids (%)	33.9±9.7	34.5±9.7	37.2±9.9	0.033[b]
Saturated fatty acids (%)	9.5 (1.0;43.2)	9.4 (1.0;43.2)	9.7 (1.7;28.7)	0.821[a]
Monounsaturated fatty acids (%)	9.0 (0.3;40.4)	8.9 (0.3;24.7)	9.8 (1.9;40.4)	0.049[a]
Polyunsaturated fatty acids (%)	10.5 (1.8;31.9)	10.5 (1.8;31.9)	10.0 (3.0;24.2)	0.370[a]
Cholesterol (mg)	164.2 (0.0;1383.3)	160.3 (0.0;1097.4)	179.2 (0.0;1383.3)	0.274[a]
Calcium (mg)	344.0 (0.0;3506.6)	335.2 (0.0;3506.6)	261.7 (11.2;1195.6)	0.001[a]
Sodium (g)	3.4 (0.2;47.6)	3.5 (0.5;34.6)	3.2 (0.2;9.9)	0.241[a]
Vitamin D (mcg)	1.5 (0.0;388.6)	1.5 (0.0;388.6)	0.8 (1.0;42.2)	0.036[a]
Iron (mg)	6.7 (0.6;84.7)	6.7 (0.6;84.7)	6.9 (1.1;37.8)	0.667[a]
Zinc (mg)	6.5 (0.3;73.6)	6.6 (0.3;73.6)	6.4 (1.6;35.2)	0.704[a]
Vitamin A (mcg)	466.2(0.0;29276.7)	479.1 (0.0;23053.7)	409.4 (1.3;29276.7)	0.506[a]
Vitamin E (mg)	27.9 (0.0;108.1)	27.9 (0.0;108.1)	28.7 (3.6;84.2)	0.947[a]
Vitamin C (mg)	48.2 (0.2;3600.5)	49.3 (0.2;3600.5)	36.8 (0.3;1204.4)	0.261[a]
Vitamin B_{12} (mcg)	1.3 (0.0;216.0)	1.4 (0.0;169.0)	1.3 (0.0;216.0)	0.498[a]
Fibers (g)	16.8 (0.4;68.7)	17.4 (0,5;68.7)	15.0 (0.4;53.0)	0.097[a]

Note: [a]Mann Whitney test; [b]Student's *t* test.

Most of the users (87.1%) breakfasted frequently, the median being 7.0 (0.0;7.0) days a week.

Individuals who breakfasted frequently were older (p=0.041), often nonsmokers (p<0.001), and had better perceived body image (p=0.006) (Table 1). Additionally, they had more meals per day (p<0.001), reported chewing foods well (p=0.037), and consumed less deep-fried foods (p<0.001), sandwich cookies (p=0.027) and alcoholic beverages - less than once a week (p=0.018). On the other hand, their water intake was inadequate (p=0.015) (Table 2).

The nutrients related to breakfasting frequently were carbohydrates (p=0.004), fats (p=0.033), calcium (p=0.001) and vitamin D (p=0.036) (Table 3). Adequate nutrient intake was associated with inadequate carbohydrate intake (p=0.017) and adequate vitamin B_{12} intake (p<0.001) (Data not shown).

Analysis of anthropometric characteristics showed that those who breakfasted frequently had lower median weight (p=0.007), and lower risk of developing metabolic disorders according to WC (p=0.020) (Table 4).

Once the model was adjusted by Poisson's multivariate analysis, associations were found between breakfasting frequently (four or more times per week) and not smoking, having five or more meals a day, appropriate consumption of deep-fried foods, lower fat intake and lower prevalence of excess weight (Table 5).

DISCUSSION

The prevalence of breakfasting frequently was high and positively associated with appropriate food and nutrient intakes, which have a positive repercussion on the body weight. It is noteworthy that this study was done in a public health service, which shows the importance of knowing the dietary profile and associated factors of its users to improve the number of health-promotion actions.

The prevalence of breakfasting was similar to those found by other studies, which varied from 25.2% to 95.0%[4,6-9,21,22]. Although skipping breakfast was unusual, it may lead to nutritional deficiencies and increase the intake of energy-dense foods, favoring the development of diseases[8,10,23].

Table 4. Nutritional status of users of a health-promotion service of *Belo Horizonte*, according to breakfasting frequency. *Belo Horizonte* (MG), 2010.

Variables	Total (n=528)	Breakfasting frequency		p value
		Frequent (n=460)	Occasional (n=68)	
Weight (kg)	69.5 (39.1;146.8)	68.8 (39.1;146.8)	73.8 (46.0;118.5)	0.007[a]
BMI (kg/m²)	28.0 (14.9;62.1)	27.9 (14.9;62.1)	28.7 (18.9;52.0)	0.168[a]
Nutritional status (%)				
Underweight	1.9	2.2	0.0	
Normal weight	27.8	28.7	21.2	0.181[b]
Excess weight	70.3	69.0	78.8	
Waist circumference (cm)	86.8±12.0	86.4±12.5	89.6±12.5	0.046[c]
No risk	32.6	33.3	27.3	
High risk	27.2	28.4	18.2	0.020[d]
Very high risk	40.2	38.3	54.5	
Waist-to-hip ratio	0.83 (0.65;1.74)	0.83 (0.65;1.48)	0.84 (0.69;1.74)	0.376[a]
No risk	54.7	55.4	50.0	0.415[d]
Very high risk	45.3	44.6	50.0	

Note: [a]Mann Whitney test; [b]Fisher's exact test; [c]Student's t test; [d]Chi-square test.
BMI: Body Mass Index.

Table 5. Poisson regression analysis for frequent breakfasting according to the characteristics of users of a health-promotion service of *Belo Horizonte* (MG), 2010.

Variables	Frequent breakfasting - RP (IC 95%)	*p* value[a]
Smoker		
Yes	1.0	
No	1.45 (1.10;1.91)	0.008
Number of daily meals		
<5 meals	1.0	
≥5 meals	1.15 (1.06;1.25)	<0.001
Intake of deep-fried foods		
Inappropriate	1.0	
Appropriate	1.12 (1.01;1.25)	0.034
Fat intake		
Low	1.0	
Appropriate	0.82 (0.73;0.93)	0.002
High	0.78 (0.68;0.89)	<0.001
Nutritional status		
Underweight	1.0	
Normal weight	0.89 (0.80;1.00)	0.057
Excess weight	0.85 (0.78;0.92)	<0.001

Note: [a]*Poisson regression.*
Adjusted by age. Model adjustment: Goodness of fit=1.00.

There are only a few studies that approach the factors associated with skipping breakfast. In general, they report a positive association between breakfasting and healthy lifestyles, such as not smoking, being physically active, controlling body weight and avoiding alcoholic beverages[3,6,7,10,24].

In agreement with other studies[6,7,10], the present study found an association between not smoking and breakfasting frequently. Smoking may reduce appetite in the morning and encourage the smoker to skip this meal[7].

Individuals who reported breakfasting frequently had more meals per day and appropriate intakes of deep-fried foods and fats. Making smaller meals, including breakfast, is mentioned in the literature as a way to avoid eating too much, which helps to control weight and avoid excess weight-associated comorbidities[9,10,25].

The greater intake adequacy of deep-fried foods and fats by those who breakfast frequently may indicate a healthier diet, that is, lower consumption of deep-fried foods and high-fat foods. Additionally, the literature has evidenced the replacement of this meal by unhealthy, high-fat snacks, such as processed cookies and chips[8,21]. Thus, breakfasting may contribute to appropriate nutrient intake, consequently promoting health and preventing disease, and accordingly, it is related to healthier behaviors that impact food choices[21].

A possible consequence of the beneficial health effects of breakfasting is the lower body weight of those who breakfast frequently. This meal has also been associated with less visceral fat and higher percentage of lean mass[9,24]. It is known that reduction of body weight and fat percentage is important for the prevention and control of diseases, especially cardiovascular diseases and glucose intolerance, and, consequently, diabetes *Mellitus*[9,24,26]. Corroborating these findings, Pereira *et al.*[10] observed better blood glucose control in people who breakfasted frequently.

Knowing the breakfasting frequency and associated factors of users of the Unified Healthcare System (*Sistema Único de Saúde* - SUS) may allow the development of more effective health actions for the population. Furthermore, such initiatives corroborate Brazilian health policies, such as the National Food and Nutrition Policy (*Política Nacional de Promoção da Saúde* - PNAM)[11] and the Health Promotion Policy[27], which strongly indicate that appropriate health and nutrition are the paths to good health.

The cross-sectional design of this study prevents an assessment of causality among the variables, such as the relationship between breakfasting and lower body weight. However, the type of study done meets the proposed objectives.

Data analysis must consider the occurrence of answer bias, since those who join a health-promotion service are probably willing to change their food habits, and so may report breakfasting more often. Still, the information analyzed herein was obtained as soon as these individuals joined the service, before any interventions were done, so minimizing the occurrence of biases.

Regarding the use of only one R24, one must consider its advantages when compared with other methods, such as the possibility of using it in health services and the fact that it records the consumption of a high variety of foods, since it is an open instrument. Notwithstanding, the collected information may be affected by the individual's recording skill and a single R24 may not reflect the individual's food habits[28]. Given these limitations, this study associated the R24 with the qualitative FFQ, and a relatively high number of individuals were studied, which improves method quality.

The present study found a positive association between breakfasting frequently and healthy life habits. This finding suggests that promoting breakfasting may contribute to the prevention and control of non-communicable chronic diseases and disorders, and to improving health and quality of life, given its relationship with smaller smoking prevalence, appropriate nutrient and food intakes and smaller body weight. The results found by the present study may help professionals working in primary healthcare and health service managers to develop and implement actions that promote breakfasting as a simple and easy strategy for health promotion, and may encourage researchers to perform more studies on the theme.

ACKNOWLEDGMENTS

We thank the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* for the scholarship, the *Coordenação de Aperfeiçoamento Pessoal de Nível Superior* for the master's scholarship and the *Fundação de Amparo à Pesquisa do Estado de Minas Gerais* for the grant. We also thank the physical educator Danielle Ibrain for allowing the study to be done at the city gym.

CONTRIBUTORS

PP FREITAS contributed substantially to study conception and planning, data analysis and interpretation, and manuscript writing. RD MENDONÇA contributed to data analysis and interpretation and critically reviewed the manuscript. ACS LOPES Contributed to study conception and planning, data interpretation and critical review of the manuscript.

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Received on: 23/4/2012
Final version on: 4/9/2012
Approved on: 13/11/2012

Qualidade nutricional e microbiológica de dietas enterais artesanais padronizadas preparadas nas residências de pacientes em terapia nutricional domiciliar[1]

Nutritional and microbiological quality of standardized homemade enteral diets for patients in home nutritional therapy

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RESUMO

Objetivo

Avaliar as propriedades físico-químicas, microbiológicas e nutricionais de dietas enterais artesanais padronizadas preparadas nos domicílios de pacientes em terapia nutricional domiciliar.

Métodos

Foram desenvolvidas duas formulações de dietas enterais (F1=1,2kcal/mL e F2=1,5kcal/mL), elaboradas com maltodextrina (155/155g), concentrado proteico de soro de leite (30/15g) e óleos vegetais (30/60g) dissolvidos em água (q.s.p.1000mL). Os cuidadores receberam os ingredientes e as medidas padrão e foram orientados quanto ao preparo e às boas práticas de manipulação. O estudo teve duração de quatro meses, e amostras das dietas preparadas nos domicílios de 33 pacientes foram coletadas e analisadas no início e no final deste período. As amostras foram avaliadas quanto à sua adequação percentual em relação aos valores prescritos de macronutrientes e energia, bem como aos padrões microbiológicos estabelecidos pela legislação vigente.

Resultados

As dietas formuladas (Formulação 1/Formulação 2) apresentaram os seguintes teores de macronutrientes, energia e osmolalidade: água - 73,5/70,0%; proteína - 4,4/6,0%; lipídeo - 4,3/6,6%; carboidrato - 16,9/16,4%; energia - 120/150kcal/100mL; osmolalidade - 440/450mOsm/kg.H_2O. As variações nas adequações percentuais das amostras domiciliares foram menores que 20,0% tanto na primeira quanto na última amostragem. As

[1] Artigo elaborado a partir da tese de VFN Santos, intitulada "Dieta enteral não industrializada para pacientes em terapia nutricional domiciliar: parâmetros físicos, químicos e nutricionais, efeito sobre a antropometria e índices bioquímicos, reprodutibilidade na preparação domiciliar e qualidade microbiológica". Universidade Federal de São Paulo; 2012.

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proporções de amostras em desacordo com os padrões legais foram significantemente menores nas amostras finais, 24,0% e 36,0% para bactérias mesófilas e coliformes, respectivamente.

Conclusão

O preparo das dietas nos domicílios apresentou boa reprodutibilidade; no entanto, a qualidade microbiológica ainda permanece uma questão preocupante, exigindo uma atuação cuidadosa do profissional de saúde nos domicílios.

Termos de indexação: Alimentos formulados. Contaminação. Controle de qualidade. Nutrição enteral. Terapia nutricional.

ABSTRACT

Objective

This study assessed the physical, chemical, microbiological and nutritional properties of standardized enteral diets prepared at the homes of patients receiving nutritional therapy.

Methods

Two enteral diet formulations were developed (F1=1.2kcal/mL and F2=1.5kcal/mL) containing maltodextrin (155/155g), whey protein concentrate (30/15g) and vegetable oils (30/60g) dissolved in water (q.s.p.1000mL). The ingredients and measuring devices were given to the caregivers, along with preparation instructions and advice on good handling practices. The study lasted four months and the diets prepared at the homes of 33 patients were collected at baseline and endline for analysis. The samples were analyzed to determine the compliance of their macronutrient and energy contents with the prescription and their microbiological contents with the legislation.

Results

The study diets (Formulation 1/Formulation 2) contained the following macronutrient and energy contents and osmolality: water - 73.5/70.0%; protein - 4.4/6.0%; lipids - 4.3/6.6%; carbohydrate - 16.9/16.4%; energy - 120/150kcal/100mL; osmolality - 440/450mOsm/kg.H_2O. The percent adequacy of the homemade diets did not vary by more than 20.0% at baseline or end of study. The percentages of samples that did not meet the legal standards were significantly lower at the end of the study: 24.0% and 36.0% for mesophilic bacteria and coliforms, respectively.

Conclusion

Homemade diets presented good reproducibility but their microbiological quality remains a matter of concern, indicating that health professionals must be careful when working at home.

Indexing terms: *Food formulated. Contamination. Quality control. Enteral Nutrition. Nutrition therapy.*

INTRODUÇÃO

A administração de dieta através da via enteral é um componente de tratamento médico bem aceito e tem contribuído significativamente para a redução da mortalidade e morbidade. O êxito deste tratamento deve-se à evolução dos conhecimentos em nutrição, no intuito de ofertar nutrientes de forma eficaz e segura[1,2].

Dentre os vários motivos para que se desenvolvam serviços de terapia nutricional em esquema domiciliar, destaca-se o crescimento da população de idosos e, consequentemente, o aumento de indivíduos portadores de doenças crônicas, necessitando de assistência de saúde por longos períodos[3,4]. Há uma série de benefícios citados na literatura quanto ao fornecimento de nutrição enteral domiciliar; no entanto, problemas irão surgir se informações e cuidados posteriores com a nutrição enteral não forem orientados adequadamente[5-7].

As fórmulas de nutrição enteral são preparadas comercialmente[8] ou manualmente[9,10]; estas últimas são denominadas não industrializadas ou artesanais. Vários estudos científicos demonstraram os benefícios de sua utilização em

terapia de nutrição enteral[11-15]. Dietas artesanais, por sua vez, são constituídas por alimentos *in natura*, produtos alimentícios e/ou módulos de nutrientes ou mesclas entre eles[10].

Nos países desenvolvidos, é comum o uso de dietas enterais industrializadas (tratamento já consagrado) e, no Brasil, o recurso a este tipo de dieta vem aumentando gradativamente. Essas dietas oferecem maior segurança quanto à qualidade microbiológica e à composição nutricional[8,11]; porém, às vezes, não estão disponíveis, por razão de custo ou logística[15]. Neste contexto, dietas artesanais ocupam um papel fundamental na recuperação do paciente que depende de sua utilização para manutenção ou recuperação do seu estado nutricional.

A despeito de ser um tratamento estabelecido, muitos questionamentos têm sido descritos na literatura sobre o uso dessas dietas, como a falta de estabilidade e incertezas quanto à composição química e ao efeito osmótico[16,17]. Além disso, há necessidade de um controle rígido das condições higiênicas no preparo, acondicionamento e administração dos alimentos[15,18]. Dietas artesanais apresentaram alto grau de contaminação mesmo quando preparadas em ambiente hospitalar[19,20].

Durante a elaboração da dieta artesanal, a falta de padronização dos procedimentos, dos ingredientes em medidas caseiras e do tempo de cocção pode contribuir para o caráter variável da composição nutricional. Resíduos retidos no processo de peneiramento também podem alterar sua composição[17]. Em dietas enterais artesanais preparadas no domicílio, com alimentos *in natura*, os valores de macronutrientes e energia podem corresponder a menos de 50% dos valores prescritos[21], resultando em administração imprecisa dos nutrientes.

Assim, planejou-se o estudo aqui descrito com a finalidade de desenvolver dietas artesanais, sem a utilização de alimentos *in natura*, de menor custo, adequadas quanto à composição nutricional e à osmolalidade, padronizadas e reprodutíveis em domicílio, e que, ainda, apresentassem maior segurança microbiológica.

MÉTODOS

O estudo foi realizado durante o período de dezembro de 2007 a maio de 2009. Desenvolveram-se duas formulações experimentais (F1 e F2), utilizando ingredientes acessíveis, adequadas quanto à composição nutricional, à concentração osmolar e à qualidade microbiológica, isentas de glúten e sacarose, e de fácil preparo. Com a finalidade de evitar variações indesejáveis nos teores dos nutrientes, objetivou-se também a padronização dos ingredientes em medidas caseiras, a fim de favorecer a reprodução em condições domésticas. Por meio de análises laboratoriais, determinou-se a osmolalidade e os teores de energia, macronutrientes e sódio das formulações.

Após esta etapa, foram selecionados 33 domicílios de pacientes sob terapia nutricional domiciliar utilizando como fonte exclusiva de alimentação dietas artesanais preparadas com alimentos *in natura*. Estas, então, foram substituídas pelas formulações experimentais, segundo a indicação clínica. A formulação F1 foi indicada para a manutenção do estado nutricional de pacientes eutróficos, enquanto a formulação F2 foi indicada para aqueles pacientes com necessidades energéticas e proteicas aumentadas. O projeto foi aprovado pelo Comitê de Ética em Pesquisa da Universidade Federal de São Paulo (Unifesp) sob o Protocolo nº 1732/08. Termo de Consentimento Livre e Esclarecido foi obtido dos diretores clínicos de quatro empresas de assistência domiciliar, responsáveis médicos dos pacientes, assim como dos familiares responsáveis que concordaram em participar do estudo.

Os cuidadores dos pacientes envolvidos no estudo foram orientados pela pesquisadora quanto ao modo de preparo e às boas práticas de manipulação e armazenamento das formulações. O acompanhamento ocorreu durante quatro meses. No início do acompanhamento, os cuidadores foram orientados verbalmente e por escrito. Além disso, observaram a demonstração passo a passo da execução da formulação feita pela pesqui-

sadora. Posteriormente, com a finalidade de avaliar a adequação à prescrição e às boas práticas de manipulação no preparo domiciliar, amostras das dietas foram coletadas para serem submetidas a análises laboratoriais físico-químicas e microbiológicas, no início e ao final do acompanhamento. Nos domicílios cujos resultados iniciais foram insatisfatórios, a pesquisadora retornou aos locais e acompanhou a execução das dietas pelos cuidadores, corrigindo as falhas observadas.

Para garantir que os pacientes recebessem a dieta experimental como foi prescrita, foram fornecidos às famílias todos os insumos necessários à preparação: matérias-primas, compostos de vitaminas e minerais, copos plásticos descartáveis, colher de café padronizada e jarras de vidro com tampa.

Desenvolvimento das formulações experimentais

As formulações foram desenvolvidas no Laboratório de Bromatologia e Microbiologia de Alimentos da Unifesp em condições semelhantes às domésticas. No seu preparo foram utilizados, como fonte de energia e macronutrientes, maltodextrina, albumina desidratada, concentrado proteico de soro de leite em pó, sal de cozinha, óleo de soja e azeite de oliva. As quantidades destes ingredientes foram padronizadas em copos plásticos descartáveis com capacidades de 300, 200 e 50mL, em medidas cheias e rasas, denominados a seguir como copos 300, 200 e 50.

Para atender às necessidades de vitaminas e minerais, foi utilizado o produto comercial Centrum®. Como este não era suficiente para suprir as necessidades diárias dos micronutrientes necessários para este grupo[22], as quantidades de vitaminas e minerais faltantes foram complementadas com compostos de minerais e vitaminas preparados em farmácia de manipulação na forma de sachês. Todas as quantidades foram calculadas para o preparo de 1000mL de formulação. Os ingredientes foram adquiridos em supermercados, lojas especializadas em suporte nutricional e farmácias, todos facilmente encontrados na cidade de São Paulo (SP). As quantidades de sal adicionadas na composição das formulações F1 e F2 foram suficientes para suprir as necessidades mínimas de iodo e manter os teores adequados de sódio nas formulações[22]. A composição nutricional das vitaminas e minerais das formulações F1 e F2 está mostrada no Quadro 1 e os demais nutrientes e osmolalidade na Tabela 1.

Preparo da F1

Colocou-se uma medida de copo 300 de maltodextrina em pó (155g) em uma tigela e homogeneizou-se em 100mL de água previamente fervida e resfriada (duas medidas de copo 50mL). A seguir, sempre misturando lentamente, adicionaram-se duas medidas de copo 50 de albu-

Quadro 1. Quantidades diárias de minerais e vitaminas das formulações experimentais. São Paulo (SP), 2009.

Nutriente	Formulações 1 e 2
Cálcio (mg)	1200
Ferro (mg)	18
Potássio (mg)	2700
Cloro (mg)	2300
Fósforo (mg)	1000
Magnésio (mg)	400
Zinco (mg)	19
Cobre (mcg)	2000
Manganês (mg)	5,0
Molibdênio (mcg)	130
Selênio (mcg)	80
Cromo (mcg)	85
Iodo (mcg)	180
Vitamina A (mcg)	1200
Vitamina D (mcg)	10
Vitamina E (mg)	25
Vitamina K (mcg)	130
Vitamina B_1 (mg)	2,4
Vitamina B_2 (mg)	2,6
Niacina (mg)	32
Vitamina B_6 (mg)	2,9
Vitamina B_{12} (mcg)	2,4
Ácido Pantotênico (mg)	10
Ácido Fólico (mcg)	540
Ácido Ascórbico (mg)	160
Colina (mg)	160
Biotina (mcg)	60

Tabela 1. Composição centesimal de água, macronutrientes, energia, sódio e osmolalidade das formulações experimentais preparadas em laboratório. São Paulo (SP), 2009.

Parâmetros	Formulação 1	Formulação 2
Água (g/100g)	73,5	70,0
Lipídeos (g/100g)	4,3	6,6
Proteínas (g/100g)	4,4	6,0
Carboidratos (g/100g)	16,9	16,4
Sódio (mg/100g)	154,0	118,0
Energia (Kcal/100g)	120,0	150,0
Kcal não proteica/gN	154:1	131:1
Osmolalidade (mOsm/Kg H_2O)	440	450

mina desidratada (24g), duas medidas de copo 50mL de proteína de soro de leite (30g), uma colher de café (1,5g) de sal de cozinha (NaCl), meia medida de copo 50mL de óleo de soja (15g) e meia medida de copo 50 de azeite de oliva (15g). Dois comprimidos de Centrum®, diluídos em meio medida de copo 50mL de água, e dois sachês de vitaminas e minerais foram adicionados à mistura. Completou-se com 700mL de água previamente fervida e resfriada (q.s.p.1000mL).

Preparo da F2

Nesta formulação, utilizaram-se as mesmas medidas de maltodextrina em pó, de sal de cozinha e de vitaminas e minerais, dobraram-se as quantidades de albumina desidratada (uma medida de copo 200mL), de óleo de soja (uma medida de copo 50mL) e de azeite de oliva (uma medida de copo 50mL), e diminuiu-se pela metade a quantidade de proteína de soro de leite (uma medida de copo 50mL). Completou-se com 700mL de água previamente fervida e resfriada (q.s.p.1000mL).

Análises laboratoriais das formulações experimentais

Para observação da estabilidade e homogeneidade, as formulações foram colocadas em béquer de vidro e armazenadas em geladeira por três horas. Ao final deste intervalo de tempo, foi feita a inspeção visual para verificar se a solução apresentava aspecto homogêneo e se ocorria separação de fases. Na avaliação da fluidez, as soluções foram passadas por equipo para observar-se a ocorrência de entupimentos.

As formulações foram analisadas para a determinação dos seguintes parâmetros: umidade, proteína, lipídeos totais, carboidratos, cinzas, sódio e energia *Association of Official Analytical Chemists* (AOAC)[23]. Teor de umidade foi obtido pelo método gravimétrico com aquecimento da amostra em estufa a 102°C, até peso constante. Os lipídeos foram determinados após hidrólise ácida e extração com éter pelo extrator de Soxhlet; proteínas, por determinação da fração nitrogenada - método Kjeldahl -, e multiplicando por 6,25 como fator de conversão; cinzas, por incineração da matéria orgânica da amostra em mufla a 500-550°C. Sódio foi obtido a partir das cinzas e determinado por espectrofotômetro de absorção atômica. Os teores de carboidratos foram determinados pela diferença e o valor energético calculado pela conversão de Atwater correspondentes à soma da multiplicação dos teores de proteínas e carboidratos por 4kcal e lipídeos por 9kcal, respectivamente.

A osmolalidade das formulações experimentais foi determinada em osmômetro (*Advanced Wide-Range Osmometer* 3W2) pelo método crioscópico, que se baseia na diminuição do ponto de congelamento à medida que se eleva a carga de soluto, obtendo-se o valor diretamente em mOsm/kg[16]. Considerou-se adequada a concentração osmolar inferior a 500 miliosmóis por quilo de água, de acordo com os parâmetros definidos pela Agência Nacional de Vigilância Sanitária (Anvisa)[24].

Orientações aos cuidadores quanto às boas práticas de manipulação e armazenamento das formulações

Os cuidadores foram encorajados a utilizar as dietas no menor tempo possível após o seu

preparo. Na impossibilidade, orientou-se que as dietas fossem acondicionadas em jarra de vidro com tampa e mantidas no compartimento superior do refrigerador, à temperatura entre 4°C e 6°C, por um período não superior a 12 horas.

Quanto à superfície de apoio ao preparo da dieta, orientações foram ministradas quanto à importância da limpeza de sujidades antes do preparo e aplicação de álcool a 70% após a limpeza. Para os utensílios utilizados no preparo, orientou-se a utilização de escaldamento com água fervente antes da utilização.

Devido à maior chance de contaminação cruzada, a utilização de panos de pratos foi desencorajada e vetada em todos os domicílios, recomendando-se o uso de toalhas de papel descartáveis. Quanto aos procedimentos de desinfecção das superfícies de apoio e de limpeza, orientou-se a desinfecção das embalagens das matérias-primas. Especial atenção foi ministrada na limpeza e desinfecção das mãos e antebraço dos cuidadores antes do preparo das formulações.

Coleta e análises laboratoriais das formulações preparadas nos domicílios

A primeira coleta de amostras das formulações preparadas nos domicílios foi agendada para a semana subsequente ao início do acompanhamento pela pesquisadora. Devido à necessidade de iniciarem-se as análises microbiológicas em até duas horas após a coleta, e considerando-se as grandes distâncias entre os domicílios e o laboratório, foi necessário contratar serviço de mensageiro em motocicleta para o transporte das amostras. Assim, após o agendamento da coleta, um mensageiro era direcionado ao local com o material necessário, que consistia em caixa térmica de isopor, frasco de vidro com tampa esterilizado e bolsa térmica em gel. As coletas das dietas nas residências foram realizadas em horários aleatórios ao preparo. No domicílio, os cuidadores, já devidamente orientados quanto aos cuidados de coleta, transferiam aproximadamente 250mL da dieta a ser consumida pelo paciente naquele dia para o frasco esterilizado, que era acondicionado na caixa térmica, e com a bolsa térmica, para manutenção da temperatura de refrigeração da amostra, e imediatamente levado para o laboratório. Os horários do mensageiro, de saída e de chegada, foram anotados para controlar o intervalo máximo de duas horas.

As amostras das dietas coletadas nos domicílios foram submetidas a análises químicas[23] e microbiológicas[25]. A partir dos teores encontrados de água, proteínas, lipídeos, carboidratos e energia, foram calculadas as adequações percentuais em relação aos teores prescritos. Na avaliação da qualidade microbiológica, foram realizadas as contagens de bactérias aeróbias facultativas mesófilas e a determinação do Número Mais Provável (NMP) de coliformes totais e de *Escherichia coli*. Os resultados foram comparados aos padrões microbiológicos definidos para estes microrganismos pela Resolução nº 63 da Anvisa. As análises estatísticas foram realizadas utilizando-se o *software Sigma Stat for Windows* 2.0[26]. Em todos os testes, fixou-se nível de significância de 5% ($p<0,05$) para a rejeição da hipótese de nulidade.

RESULTADOS

As formulações F1 e F2 apresentaram-se homogêneas, com aspecto uniforme, não ocorrendo separação de fases após três horas do preparo, isentas de sacarose e glúten. Na análise da fluidez, as formulações passaram pelo pela equipo sem entupimentos, demonstrando que a concentração de sólidos existente na formulação permitiu um escoamento adequado das soluções.

Na Tabela 1 estão mostradas as composições centesimais das duas formulações desenvolvidas em laboratório. A F2 apresenta quantidade de energia 25% maior que na formulação F1, devido à maior quantidade de lipídeos e proteínas existentes nessa formulação. A formulação F2 apresentou maior densidade energética e maior proporção de nitrogênio por calorias não proteicas. A concentração osmolar foi adequada aos parâmetros exigidos pela legislação nas duas formulações.

Os valores expressos em mediana e percentis P25 e P75 da adequação percentual de água, macronutrientes e energia das duas dietas preparadas nos domicílios, nas amostras iniciais e finais, estão mostrados na Tabela 2. Observa-se que houve maior adequação à prescrição para água, tanto nas amostras iniciais e quanto nas finais. Quanto aos lipídeos e carboidratos, verificou-se que aumentou a adequação à prescrição nas amostras finais, sendo estas diferenças estatisticamente significativas. Energia também mostrou maior adequação ao final. O inverso foi observado em relação às proteínas, ocorrendo um aumento de sua quantidade e, consequentemente, uma diminuição da adequação à prescrição nas amostras finais, sendo esta diferença estatisticamente significativa.

Na Tabela 3, observa-se a mediana e percentis P25 e P75 das contagens de bactérias mesófilas, coliformes totais e *E. coli* de amostras das dietas (F1 ou F2) preparadas nos domicílios, coletadas no início e ao final. Os valores das contagens das bactérias mesófilas e coliformes totais foram significativamente menores nas amostras finais, quando comparados àqueles valores de início; o mesmo não ocorreu com os valores das contagens de *E. coli*.

Quanto à adequação das dietas preparadas no domicílio aos padrões microbiológicos, 36% e 24% das amostras estavam adequadas quanto a bactérias mesófilas e coliformes, respectivamente, no início do acompanhamento; ao final, estas proporções aumentaram para 76 e 64%, respectivamente.

Na Tabela 4 estão os resultados das amostras das dietas F1 e F2, preparadas nos domicílios, no início e no final do acompanhamento. O teste de McNemar mostrou que o número de amostras em desacordo para bactérias mesófilas e coliformes totais foi significativamente menor ao final do acompanhamento. Quanto aos resultados de *E. coli*, o teste estatístico mostrou que, naqueles domicílios cujas amostras iniciais estavam positivas, estas permaneceram positivas também nas amostras finais.

O consumo médio das dietas F1 e F2 pelos pacientes foi de 1500mL/dia. A partir destes dados, apurou-se o custo médio de R$12,70 para F1(1,2kcal/mL) e de R$12,30 para F2 (1,5kcal/mL) no primeiro trimestre de 2012, a partir de pesquisa de preços junto aos fornecedores de matéria-prima. Neste mesmo período, os preços médios das dietas industrializadas líquidas de 1,2kcal/mL e 1,5kcal/mL foram de R$19,88 e R$36,75, respectivamente.

Tabela 2. Adequação, em porcentagens, dos teores de macronutrientes e da densidade energética das dietas artesanais preparadas nos domicílios dos pacientes em relação à prescrição dietética. São Paulo (SP), 2011.

	Início n=33	Final n=33	*p*
Água	98 (97/103)	98 (96/101)	0,134[a]
Proteínas	105 (93/112)	110 (102/125)	0,002[a]
Lipídeos	133 (120/156)	114 (98/136)	0,007[a]
Carboidratos	88 (75/96)	94 (89/105)	0,006[a]
Energia	111 (99/121)	105 (101/118)	0,537[a]

Nota: [a] Teste de Wilcoxon: mediana e percentis 25 e 75.

Tabela 3. Análise microbiológica de amostras de dietas artesanais experimentais preparadas em domicílios de pacientes em terapia nutricional domiciliar. São Paulo (SP), 2011.

Contagens org./mL	Inicial n=33	Final n=33	*p*[a]
Mesófilas	1,870 (122/14,325)	15 (5/295)	<0,001
Coliformes totais	130 (4/2,400)	1 (0/24)	<0,001
E. coli	0 (0/0)	0 (0/0)	*p*=0,219

Nota: [a] Teste de Wilcoxon: mediana e percentis 25 e 75.

Tabela 4. Números de amostras de dieta enteral preparadas nos domicílios, em desacordo com os padrões microbiológicos. São Paulo (SP), 2011.

Mesófilas (>1 000ufc/mL)		Amostras iniciais		Total	*p*
		Sim	Não		
Amostra finais	Sim	6	1	7	0,002[a]
	Não	14	12	26	
	Total	20	13	33	
Coliformes totais (>3/mL)		Sim	Não	Total	*p*
Amostra finais	Sim	10	2	12	
	Não	15	6	21	0,004[a]
	Total	25	8	33	
Escherichia coli (>3/mL)		Sim	Não	Total	*p*
Amostra finais	Sim	3	0	3	
	Não	0	30	30	N.A.
	Total	3	30	33	

Nota: [a] Teste de McNemar; N.A.: Não Avalizável.

DISCUSSÃO

Escolher e adequar as fontes de nutrientes nas dietas artesanais é uma tarefa difícil e complexa para os nutricionistas. Além de adequadas quanto à composição nutricional e quanto à qualidade microbiológica, estas formulações devem ser estáveis e apresentar viscosidade e concentração osmolar apropriadas. A estas dificuldades somam-se, nos domicílios, os desafios de orientar e treinar os cuidadores para que estas formulações possam cumprir seu papel na recuperação e manutenção da saúde de pacientes em assistência domiciliar.

No estudo aqui descrito, muitos destes obstáculos foram vencidos - as formulações mostraram-se adequadas quanto às suas propriedades nutricionais e físico-químicas. Obteve-se sucesso, também, na observância, pelos cuidadores, das quantidades de ingredientes na preparação das formulações. As variações da adequação percentual de macronutrientes e energia, nas amostras coletadas nas residências, foram menores que 20%. A título de comparação, esta é a variação permitida pela Anvisa para rotulagem nutricional de alimentos industrializados[27]. Este resultado demonstrou que a padronização de medidas foi eficaz para manter as formulações dentro de variações aceitáveis, permitindo uma administração mais precisa de nutrientes.

Quanto à escolha da matéria-prima a ser utilizada na preparação, optou-se pela utilização da albumina desidratada e da proteína do soro do leite como fontes de proteína nas formulações (F1 e F2). No seu processamento, a albumina desidratada sofre um processo de pasteurização que aumenta a sua segurança microbiológica, quando comparada à utilização da clara do ovo *in natura*, assim como também elimina fatores antinutricionais presentes na clara do ovo crua (avidina)[28].

Como fonte de carboidratos, a utilização da maltodextrina teve como vantagens a facilidade de diluição em água; o fato de ser insípida; de ter baixa osmolalidade; de não apresentar sobrecarga de solutos[15]; não elevar rapidamente os índices glicêmicos devido o esvaziamento gástrico ser mais lento quando comparado aos açúcares simples como a sacarose. Neste estudo, dez pacientes diabéticos utilizaram as formulações experimentais sem apresentar alterações nos níveis glicêmicos. Estas vantagens compensaram a sua utilização apesar do maior custo em relação à sacarose. A hipótese de acrescentar o amido de milho nas formulações foi descartada por apresentar propriedade constipante.

A utilização de fibras na dieta implica elevação no custo e aumento da viscosidade da dieta artesanal, sendo que dietas industrializadas sem fibras são comumente utilizadas na prática clínica

sem prejuízos a muitos pacientes. No estudo realizado, para aqueles pacientes que apresentaram alteração do ritmo intestinal foram prescritos sachês de fibra em pó utilizados na água de hidratação, nos intervalos entre as dietas, até a normalização dos distúrbios.

A qualidade microbiológica de dietas artesanais ainda permanece como motivo de preocupação. Neste estudo, proporção expressiva de amostras - aproximadamente 40% -, das dietas preparadas nos domicílios apresentaram-se em desacordo com os padrões microbiológicos, ainda que tenha ocorrido diminuição estatisticamente significativa de desacordo ao final do acompanhamento, fato relacionado à facilidade no preparo da dieta, pela utilização de medidores padronizados e rápida execução, e também devido ao reforço das orientações da pesquisadora aos cuidadores quanto às boas práticas de manipulação durante a elaboração, armazenamento e distribuição da dieta.

A análise estatística também mostrou que, naqueles domicílios cujas amostras iniciais estavam positivas para *E. coli*, estas permaneceram positivas também nas amostras finais. Estes resultados indicam que, possivelmente, maior atenção deve ser dada, pelos profissionais de saúde, à qualidade microbiológica de dietas não industrializadas, no sentido de corrigir as falhas de manipulação. É possível, também, que nem todos os domicílios tenham condições de preparar dietas não industrializadas. Neste caso, será necessária uma avaliação cuidadosa do profissional de saúde *in loco* para definir aqueles que estão ou não aptos.

CONCLUSÃO

Os resultados desta pesquisa permitem concluir que foi possível tanto o desenvolvimento de dietas artesanais nutricionalmente adequadas como a sua reprodução em ambiente domiciliar, devido ao uso de medidas padronizadas e de orientação aos cuidadores sobre o modo de preparo. Portanto, estas formulações experimentais apresentam-se como opção para uma individualização de dieta enteral por sonda enteral ou gastrostomia na terapia nutricional domiciliar.

As contagens de micro-organismos, indicadoras de condições higiênicas inadequadas nos domicílios, apontam para a necessidade de melhor controle quanto às Boas Práticas de Manipulação (BPM) durante o preparo, armazenamento e administração das dietas. Assim, os autores sugerem a criação de um instrumento específico de BPM nos domicílios, para uma investigação mais acurada quanto às causas da contaminação das dietas nas residências.

AGRADECIMENTOS

Ao Conselho Nacional de Desenvolvimento Cientifico e Tecnológico, pelo apoio à pesquisa por intermédio do Programa de Pós-Graduação em Nutrição da Universidade Federal de São Paulo, concedendo bolsa de estudos a um dos pesquisadores.

COLABORADORES

VFN SANTOS participou da concepção e do desenho do estudo, da coleta, análise e interpretação dos dados e da redação do artigo. A BOTTONI participou da concepção e do desenho do estudo, da análise e da interpretação dos dados, e da revisão da redação do artigo. TB MORAES participou da concepção e do desenho do estudo, da análise e interpretação dos dados, da revisão da redação do artigo e da aprovação final da versão a ser publicada.

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Recebido em: 4/5/2012
Versão final em: 30/7/2012
Aprovado em: 13/11/2012

Lipid and lipoprotein responses of dyslipidemic patients to exclusive nutritional counseling by gender and age

Resposta nos lípides e nas lipoproteínas séricas ao aconselhamento nutricional exclusivo em indivíduos dislipidêmicos segundo o sexo e a idade

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ABSTRACT

Objective

The aim of the present study was to evaluate the plasma lipid responses of dyslipidemic patients to nutritional counseling according to gender and age.

Methods

One-hundred and twenty nine dyslipidemic subjects comprised the study, 56 men and 73 women, aged 20 to 73 years, treated at the Dyslipidemia Outpatient Clinic of the *Universidade Estadual de Campinas* Clinic Hospital. The inclusion criteria established that no lipid-lowering medication had been used in the 30 days prior to and during the nutritional counseling. Blood samples were collected in the morning after a 12 hour fast. The participants were divided into groups according to gender and age (age <60 and ≥60 years). The hypercholesterolemic patients were instructed to restrict saturated fats (<7%) and cholesterol (<200mg/day). Those presenting with high triglyceride levels (>300mg/dL) were asked to consume a low fat diet. Those with mixed hyperlipidemia were instructed to do both. Statistical analyses included the Wilcoxon, Mann-Whitney, Chi-square and Fisher's exact tests and Analysis of Covariance.

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Results

After nutritional counseling, total cholesterol and triglycerides decreased by 16% and 36% in males, and by 12% and 26% in females, respectively, and Low Density Lipoprotein-cholesterol decreased by 12% in females. Only triglycerides decrease significantly. In the mixed hyperlipidemia group, the male and female triglyceride (-44% and -29%), Low Density Lipoprotein-cholesterol (+12% and -15%) and High Density Lipoprotein-cholesterol (+7% and -3%) levels differed significantly. Between the age groups, only triglyceride levels differed significantly, with adults experiencing the highest reductions (33%).

Conclusion

Nutritional counseling effectively lowered plasma lipid and lipoprotein levels, reinforcing the benefits of dietary interventions for the treatment of dyslipidemia.

Indexing terms: Age groups. Diet. Dyslipidemias. Gender. Nutritional counseling.

RESUMO

Objetivo

Avaliar a resposta do perfil lipídico e das lipoproteínas plasmáticas ao aconselhamento nutricional em indivíduos dislipidêmicos analisando as respostas entre os sexos e as faixas etárias.

Métodos

Participaram do estudo 129 indivíduos dislipidêmicos, 56 homens e 73 mulheres, de 20 a 73 anos, atendidos no Ambulatório de Dislipidemias do Hospital de Clínicas da Universidade Estadual de Campinas. Os critérios de exclusão foram: uso de medicação hipolipemiante no mínimo 30 dias antes da entrevista inicial e/ou durante o acompanhamento. Os participantes foram divididos em grupos segundo sexo e faixa etária (≥60 ou <60 anos). Orientou-se restrição de gorduras saturadas (<7%) e colesterol (<200mg/dia), além das gorduras totais (<20%) para valores de triglicérides >300mg/dL, nos hipercolesterolêmicos. Na hiperlipidemia mista utilizou-se ambas orientações.

Resultados

No sexo masculino, a redução de colesterol total e triglicerides foi de 16% e 36% respectivamente; no feminino 12%, 26%, e de 12% para a Lipoproteína de Baixa Densidade, com significância apenas para o triglicerides. Na hiperlipidemia mista, as diferenças entre os sexos foram significativas para triglicerides (-44% e -29%), Lipoproteína de Baixa Densidade (+12% e -15%) e Lipoproteína de Alta Densidade +7% e -3%), respectivamente. Entre as faixas etárias, a diferença foi significativa apenas para o triglicerides; os adultos apresentaram maiores reduções (33%).

Conclusão

O aconselhamento nutricional mostrou-se efetivo na redução de lípides e lipoproteínas plasmáticos, reforçando os benefícios das intervenções dietéticas no tratamento das dislipidemias.

Termos de indexação: *Grupos etários. Dieta. Dislipidemias. Sexo. Aconselhamento nutricional.*

INTRODUCTION

Cardiovascular Disease (CVD) is the leading cause of mortality in men and women in the United States[1] and the leading cause of disability and premature death worldwide[2]. In Brazil, it is the main cause of death and the second cause of hospitalization[3].

In addition to the risk factors for Coronary Heart Disease (CHD), namely age, hypertension, diabetes, smoking, low High Density Lipoprotein-cholesterol (HDL-c) level (<40mg/dL), and high Low Density Lipoprotein-cholesterol (LDL-c) level (>160mg/dL), being male also increases the risk of CHD[4].

The strongest dietary determinants of high LDL-c are saturated fat and trans fat intakes, and to a lesser extent, cholesterol intake and excess body weight[5].

Excessive carbohydrate intake and alcohol can cause or exacerbate hypertriglyceridemia

because of high hepatic synthesis of triglycerides, production of Very Low-Density Lipoprotein-cholesterol (VLDL-c), and reduction of triglyceride-rich lipoprotein catabolism[6].

The IV Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis (*Diretriz Brasileira Sobre Dislipidemias e Prevenção da Aterosclerose*)[7] and the National Cholesterol Education Program[4] (NCEP) recommend that individuals with high cholesterol levels should limit the saturated fat intake to less than 7% of the total energy intake and cholesterol intake to less than 200mg per day; individuals with high triglyceride levels should limit carbohydrate intake to less than 60% of the total energy intake, avoid simple sugars such as sucrose, limit alcohol intake and reduce total fat intake[6].

A number of factors, such as age, gender, genetic makeup, baseline serum cholesterol level and habitual diet, alone or in combination, can impact study outcomes and strongly affect study conclusion[8].

There are a few studies in the literature that assess how gender affects the variation of serum lipid levels in response to dietary inverventions[9]. Some studies show that men experience a greater reduction in LDL-c in response to diet[10,11], whereas others did not find any gender-related difference[12].

The objective of the present study was to evaluate how the plasma lipid and lipoprotein levels of hyperlipidemic patients respond to diet and analyze the response by gender and age (<60 and ≥60 years).

METHODS

The study included 129 individuals, 56 males and 73 females, aged 20 to 73 years treated at the Dyslipidemia Outpatient Clinic of the *Universidade Estadual de Campinas* (Unicamp) Clinic Hospital. They were referred to the Nutrition Service for follow-up and advice on better lifestyle habits.

The exclusion criteria were the use of lipid-lowering medications in the 30 days prior to and during the nutritional counseling. Other medications were allowed.

Blood samples were collected in the morning after an overnight fast of at least 12 hours. The participants were also instructed to abstain from doing physical activities during that period. The biochemical analyses were done by an automated system using enzymatic colorimetric methods, and LDL-c was estimated by Friedewald's[13] equation when Triglycerides (TG) level was <400mg/dL. All biochemical analyses were done at the biochemistry division of the Clinic Hospital. Non HDL-c (NHDL-c) was given by the formula: C-HDL-c[4].

The cutoffs for the diagnosis of dyslipidemias were those provided by the IV Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis[7], which are: isolated hypercholesterolemia (C>200mg/dL and TG<150mg/dL); isolated hypertriglyceridemia (C<200mg/dL and TG> 150mg/dL); mixed hyperlipidemia (C>200mg/dL and TG>150mg/dL); and hypoalphalipoproteinemia (HDL-c<40mg/dL) found in the 3 types of dyslipidemias.

The risk factors for Coronary Artery Disease (CAD), in addition to high LDL-c, were hypertension (blood pressure ≥140:90mmHg), diabetes (fasting blood glucose ≥126mg/dL), smoking daily regardless of amount, early-onset atherosclerosis in first-degree male relatives <55 years and first-degree female relatives <65 years, and ages ≥45 in men and ≥55 in women[4].

Body Mass Index (BMI) was used for determining the nutritional status of the participants and Waist Circumference (WC) for identifying their risk of metabolic syndrome[14,15].

The participants were grouped by gender (56 men and 73 women) and age (106 adults aged <60 years and 23 elderly aged ≥60 years). The nutritional follow-up by gender lasted: 3 months (10 men and 14 women), 6 months (29 men and 33 women), 12 months (17 men and 26 women);

and by age group, 3 months (19 adults and 5 elderly), 6 months (52 adults and 10 elderly) and 12 months (35 adults and 8 elderly).

Habitual diet was determined by a 24 hour recall and by collecting information about foods and preparations consumed regularly[16,17].

Energy (kcal), macronutrient (%), cholesterol (mg/day), saturated fat (%), monounsaturated fat (%) and polyunsaturated fat (%) intakes were estimated by the Nutrition Support Program of the *Universidade Federal de São Paulo*[18].

Dietary counseling was provided after quantitative and qualitative dietary assessment, which consisted of adjusting the intakes of energy, total fat, especially saturated fat (≤7% of total calories), cholesterol (≤200mg/day), fiber and other nutrients according to the type of dyslipidemia and presence of other diseases. The participants were also instructed about the selection, preparation and recommended amounts of food substitutes.

Individuals with high triglyceride levels were advised to limit the intake of simple carbohydrates and alcoholic beverages. If TG>300mg/dL, they were also asked to reduce total fat intake (<20% of total calories). Individuals with mixed hyperlipidemia were instructed to follow both recommendations[7].

Dietary recommendations were personalized according to the participant's needs. Overweight participants (80% of the total) were given a low-energy diet and instructed to gradually decrease energy intake[19].

A follow-up interview was done to assess adherence to nutritional counseling. The participants were asked about their adherence to the prescribed diet, difficulties and doubts. Serum lipid and lipoprotein levels, weight and BMI were also measured, comparing the new results with the baseline results.

Diet adequacy was determined by biochemical tests, anthropometric parameters and adherence to nutritional counseling, emphasizing the importance of following the diet plan. Information about the participants' progress was recorded in their medical records in the institution's database.

There were at least 2 and at most 3 clinical and nutritional follow-ups. The first follow-up occurred from 30 to 90 days after the nutritional intervention. The frequency of and interval between the other follow-up visits depended on the participants' response to nutritional counseling and severity of dyslipidemia.

The study was approved by the Research Ethics Committee of *Universidade Estadual de Campinas*, School of Medicine under protocol number 647/2005.

Statistical Analysis

The statistical analyses were done by the software Statistical Analysis System (SAS) for Windows, version 6.12 and included the Wilcoxon, Chi-square, Mann-Whitney and Fischer's exact tests, and Analysis of Covariance (Ancova). The significance level was set at 5%, with borderline values of $p>5$ and <10%.

RESULTS

Table 1 shows the clinical, anthropometric, and lipid and lipoprotein profiles of the participants.

Women's mean age was higher than that of men. On the other hand, men and adults were heavier, and men had higher waist circumferences. The baseline lipid and lipoprotein levels of the participants were very high. Hypertension was more common in women and in the elderly. Men and adults had higher energy intakes, and women had higher saturated fat intake. The participants also presented high protein, fat and cholesterol intakes (Table 2).

After nutritional counseling, participants' C, TG, LDL-C and non-HDL-C decreased by 14%, 30%, 5% and 17%, respectively (Figure 1).

When the results were analyzed according to type of dyslipidemia, the TG levels of individuals

with isolated hypertriglyceridemia decreased significantly, by 45% (p=0.04).

The decrease in lipid and lipoprotein levels in response to the diet, according to gender, was: 16% for C (p<0.001), 36% for TG (p<0.001) and 21% for non-HDL-c (p<0.001) for men and 12% for C (p<0.001), 26% for TG (p<0.001), 12% LDL-c (p<0.001) and 14% for NHDL-c (p<0.001) for women. The decrease in the TG levels of men and women differed significantly.

Men and women with hypercholesterolemia presented similar decreases in C and LDL-C in response to diet (15% and 20%, respectively) (Figure 2A).

In response to diet, the males in the mixed hyperlipidemia group saw reductions of 18% in C, 23% in NHDL-C and 44% in TG and an increase of 7% in HDL-C; females saw reductions of 13% in C, 14% in non-HDL-C, 29% in TG and 3% in HDL-C, in addition to a 15% reduction in LDL-C.

Table 1. Clinical, anthropometric and biochemical characteristics of the participants.

Parameters	Total (129)	Men (n=56)	Women (n=73)	Adults (n=106)	Elderly (n=23)
Age (years)	52±11 (20-73)	44±9 (22-65)	52±11* (20-73)	45±9 (20-60)	64±4 (61-73)
Weight (kg)	74 ±13 (44-136)	84±14 (58-123)	69±13* (42-134)	77±15 (46-136)	69±12† (44-105)
BMI (W/H2)	29±5 (16-51)	29±5 (21-42)	28±5 (16-51)	29±5 (21-51)	28±4 (16-35)
Waist circumference (cm)	92±13 (61-145)	97±12 (72-123)	87±12* (61-145)	92±13 (70-145)	90±13 (61-118)
C (mg/dL)	263±50 (126-429)	260±53 (126-413)	266±48 (157-429)	261±49 (126-413)	275±54 (164-429)
LDL-c (mg/dL)	163±61 (27-356)	140±61 (35-254)	180±55 (27-356)	157±61 (27-314)	199±55 (95-356)
HDL-c (mg/dL)	47±17 (16-112)	42±17 (16-112)	51±15 (22-91)	46±17 (16-112)	53±15 (22-78)
NHDL-c (mg/dL)	219±48 (102-381)	221±52 (102-381)	218±45 (124-375)	218±47 (102-81)	224±52 (136-375)
VLDL-c (mg/dL)	41±19 (9-79)	43±23 (9-78)	40±17 (15-71)	42±19 (9-78)	38±18 (15-61)
TG (mg/dL)	364±308 (46-1837)	483±403 (46-1837)	273±159 (72-795)	388±328 (46-1837)	253±154 (72-522)
Frequency (%)					
Hypercholesterolemia	25	21	27	23	30
Hypertriglyceridemia	11	11	11	22	18
Mixed hyperlipidemia	63‡	68	60	54	52
Hypoalphalipoproteinemia	38	50§	28	42¶	18
Hypertension	39	21	52//	32	69¶
Diabetes *Mellitus*	11	16	8	10	17
CAD family >55 M >65 W	9	10	8	11	
Age ≥45y W ≥55y M	47	46	48	35	100
Smoking	13	19	8	15	4

Note: p=Mann Whitney adjusted for age, weight and Waist circumference e to gender and weight-for-age (Ancova): *p<0.001 for gender, and †p=0.018 for age, p=Chi-square; ‡p<0.001 all the groups; §p=0.014; //p<0.001 and for gender; ¶p<0.001 for age.

Adults (<60 years) and elderly (≥60 years). Values expressed as means ± Standard Deviation (SD), frequency (%), and minimum and maximum ( ) for each group. M: Men; W: Women; C: Cholesterol; LDL-c: Low Density Lipoprotein-cholesterol; HDL-c: High Density Lipoprotein-cholesterol; NHDL-c: Non-HDL-C; VLDL-c: Very Low Density Lipoprotein-cholesterol; TG: Triglycerides; CAD: Coronary Artery Disease.

Table 2. Twenty-four-hour recall of the participants according to gender and age.

Nutrients (%)	Men (n=27)	Women (n=24)	Adults (n=44)	Elderly (n=7)
Calories	2312±552	1811±364*	2151±520	1600±343†
Carbohydrates	46±8	46±8	45±8	51±6
Proteins	20±4	18±4	20±4	18±5
Fats	33±9	35±9	35±9	31±9
Saturated fats	9±3	11±4*	10±4	11±5
Monounsaturated fats	9±3	10±4	9±3	10±5
Polyunsaturated fats	8±3	8±3	8±3	7±2
Cholesterol (mg)	294±112	295±32	281±113	256±87

Note: *p*=Mann-Whitney; *$p<0.001$,*$p=0.046$ for gender; †$p=0.009$ for age.
Adults (<60 years) and elderly (≥ 60 years). Data are expressed as means ± Standard Deviation.

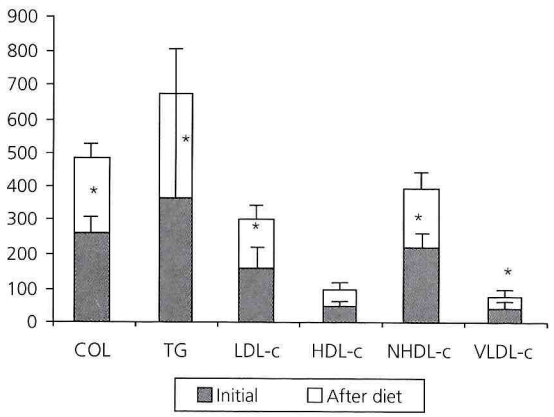

Figure 1. Lipid and lipoprotein profiles at baseline and after nutritional counseling.

Note: C: Cholesterol; TG: Triglycerides; LDL-c: Low Density Lipoprotein-cholesterol; HDL-c: High Density Lipoprotein-cholesterol; VLDL-c: Very Low Density Lipoprotein-cholesterol. NHDL: Non High Density Lipoprotein-cholesterol.
Data are expressed as means ± Standard Deviation. *p= Wilcoxon adjusted for change in weight (Ancova). C, NHDL-c, TG and VLDL-c ($p<0.001$); LDL-c ($p<0.02$).

The TG, LDL-C and HDL-C of this group also improved significantly in response to diet (Figure 2C).

Between the age groups, diet reduced the C, TG and NHDL-C levels of adults by 14%, 33% and 17%, respectively, and reduced the C of the elderly by 14%. In this group, only TG differed in response to diet (Figure 3).

Although most participants lost weight (4%), the amount of weight lost was not statistically significant.

DISCUSSION

The present study assessed how the serum lipid and lipoprotein levels of dyslipidemic individuals respond to nutritional counseling by gender and age.

The study participants presented high plasma lipid and lipoprotein levels, and some also presented other risk factors for CHD, such as diabetes (11%) and hypertension (39%), which were more prevalent in women (52%) and in the elderly (69%).

High protein intake associated with high saturated fat and cholesterol intakes suggest that diet may contribute to the development of dyslipidemia[20,21].

The 24 hour recall[16] used in this study to assess habitual food intake, especially foods and preparations associated with dyslipidemias, was relevant for the nutritional intervention. According to Willett[17], the semi-quantitative food frequency questionnaire is the main dietary assessment method used in epidemiological studies of disease.

The presence of overweight and obese participants shows the association already described in the literature between excess weight and changes in plasma lipid levels and risk of coronary artery disease[22].

Visceral obesity was more prevalent in men, indicating their higher risk of developing the metabolic syndrome[23].

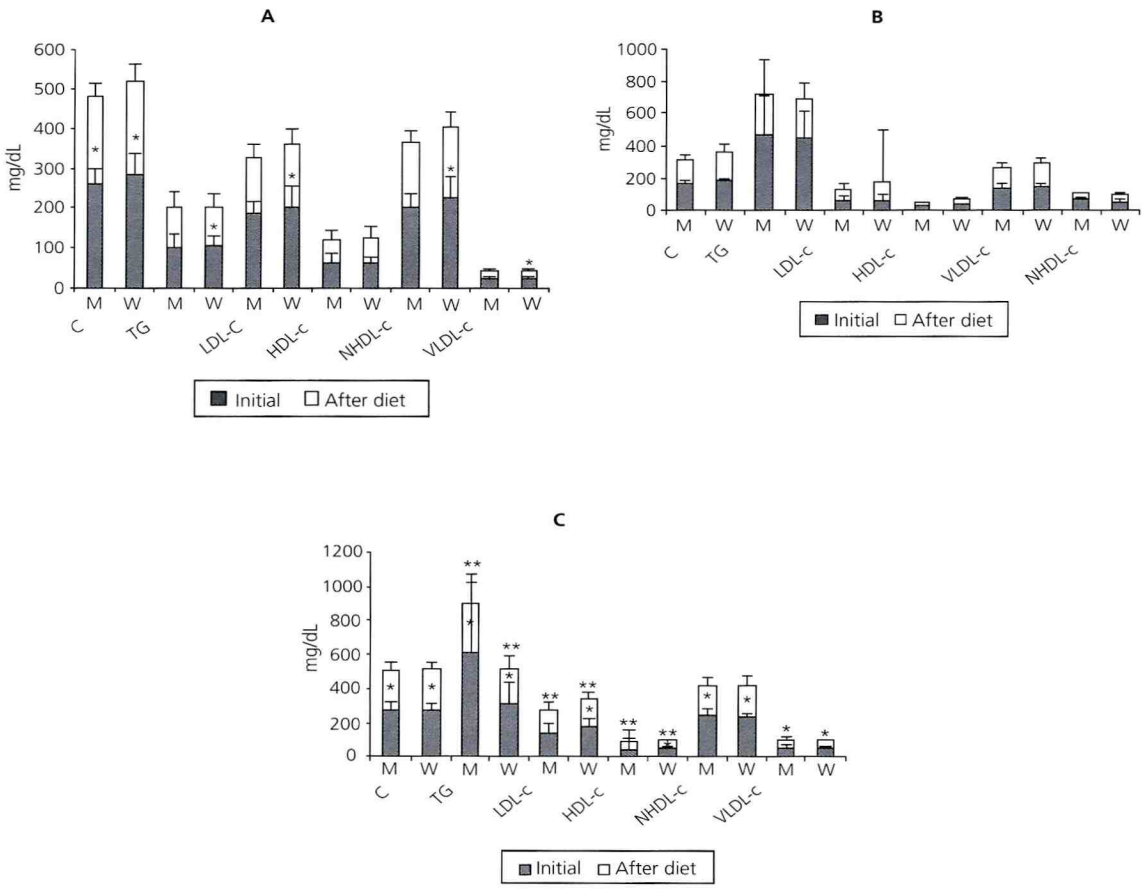

Figure 2. (A) Lipid and lipoprotein profiles at baseline and after nutritional counseling in individuals with hypercholesterolemia by gender. (B) Lipid and lipoproteins profiles at baseline and after nutritional counseling in individuals with hypertriglyceridemia by gender. (C) Lipid and lipoprotein profiles at baseline and after nutritional counseling in individuals with mixed hyperlipidemia by gender.

Note: *p= Wilcoxon adjusted for change in weight (Ancova). C (p=0.008), LDL-c (p=0.011), NHDL-c (0.016), TG and VLDL-c (p<0.001) for women; M: Men; and W: Women; C: Cholesterol; TG: Triglycerides; LDL-c: Low Density Lipoprotein-cholesterol; HDL-c: High Density Lipoprotein-cholesterol; VLDL-c: Very Low Density Lipoprotein-cholesterol; NHDL: Non High Density Lipoprotein-cholesterol.

Data are expressed as means ± Standard Deviations. C (p=0.04) for men. *p=Wilcoxon adjusted for change in weight (Ancova). *p=Wilcoxon adjusted for change in weight (Ancova) C, TG, LDL-c, NHDL for women, and C, TG, NHDL-c (p<0.001) for men; VLDL-c (p=0.02) in men and (p=0.006) in women **p=Mann-Whitney for TG (p=0.004), LDL-c (p=0.02), and HDL-c (p=0.04).

The nutritional status of participants according to BMI was: 15% normal weight, 52% overweight, 24% obesity class I, 6% obesity class II, and 3% obesity class III. Comparison of the baseline BMI with the BMI at last visit showed a substantial improvement in nutritional profile: normal-weight individuals increased from 15% to 25%, obesity class I decreased from 24% to 17%, obesity class II decreased from 6% to 5% and obesity class III decreased from 3% to 1%. However, the percentage of change in body weight was not statistically significant.

Interestingly, the TG levels of men and adults responded better to diet than those of women and the elderly.

The different TG responses of men and women, adults and the elderly found in this study suggest that the participants who had high baseline TG levels responded better to the low

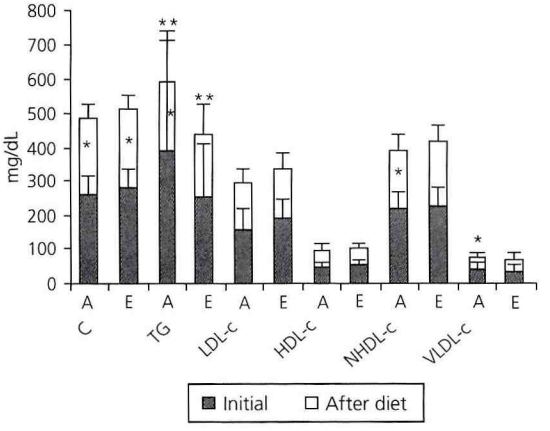

Figure 3. Lipid and lipoprotein profiles at baseline and after nutritional counseling in adults and elderly.

Note: *p=Wilcoxon adjusted for change in weight (Ancova); C, TG, VLDL-c, NHDL (p<0.001) for adults and C (p=0.03) for elderly.**p=Mann-Whitney; TG (p=0.01). <60 years (A) and ≥60 year (E); C: Cholesterol; TG: Triglycerides; LDL-c: Low Density Lipoprotein-cholesterol; HDL-c: High Density Lipoprotein-cholesterol; VLDL-c: Very Low Density Lipoprotein-cholesterol. NHDL: Non High Density Lipoprotein-cholesterol; A: Adults; E: Elderly.
Data are expressed as means ± Standard Deviation.

fat diet (<20%). Similar results were found by Jacobs *et al.*[24].

Moreover, the greatest reductions in LDL-c levels were seen in women with mixed hyperlipidemia, suggesting that women might be more sensitive to dietary saturated fat, responding better to LDL-c restriction[25].

The reductions in C and LDL-c levels achieved by men and women with isolated hypercholesterolemia as a response to diet were similar.

Some studies with individuals with moderate hypercholesterolemia shows that the reduction of LDL-c in response to diet is higher in men than in women[10-11], whereas other studies show that the reductions in total cholesterol and apolipoprotein B also are higher in men[26,27]. Corroborating this study, some authors found that the reductions in C and LDL-c in response to diet do not differ between genders[8,12,25,28].

The TG levels of males with mixed hyperlipidemia responded better to diet than those of women. On the other hand, women saw greater reduction in LDL-c. Furthermore, the HDL-c of men in response to diet increased significantly, while that of women decreased.

The decrease in the HDL-c of women in response to diet was also reported by Walden *et al.*[25-29] and Yu-Poth *et al.*[30].

Changes in lipid and lipoprotein levels were mostly significant, even after adjustment for changes in body weight, highlighting the effectiveness of the dietary intervention used in this study.

The present study has also shown the importance of dietary counseling for patients treated at the outpatient clinic of the university hospital, which achieved a cholesterol reduction of 12% to 16%, TG reduction of 30% to 45% and LDL-c reduction of 15% to 20%. These responses were greater than the biological variation coefficients for each study parameter (C=6%, TG=23%, LDL-c=9.5%)[31].

Nutritional counseling proved to be more effective for males and adults, suggesting that new nutritional approach strategies are needed for females and the elderly, including number of follow-up visits, frequency and interval between visits.

Although 30% of the participants needed to start lipid-lowering drugs, the reductions in lipid levels decreased the number of participants who needed lipid-lowering drugs and the dosages these participants required, resulting in lower health expenses. Therefore, this study reinforces that dietary changes are effective and feasible for the public health system.

Since cardiovascular disease is the leading cause of hospitalization and death, this positive therapeutic procedure should be implemented by other health services in Brazil because it is inexpensive[32-34] and may help to reduce expenses, and prevent and control CHD.

ACKNOWLEDGEMENTS

We thank Helymar Machado for the excellent statistical analyses, and the *Conselho Nacional de*

Desenvolvimento Científico e Tecnológico and *Fundação de Amparo à Pesquisa do Estado de São Paulo* for sponsoring the study.

CONTRIBUTORS

H KINCHOKU wrote the article as part of thesis dissertation. VS CASTANHO helped with the clinical and laboratory follow-up of the patients and article review. MRG DANELON performed the laboratory analyses. EC FARIA participated in all stages of this study, including article writing.

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Received on: 18/1/2012
Final version on: 1/10/2012
Approved on: 12/11/2012

Which equation should be used to measure energy expenditure in HIV-infected patients?[1]

Qual equação utilizar para avaliar gasto energético de portadores do HIV?

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ABSTRACT

Objective

In view of the practical need to use equations for the evaluation of energy expenditure in HIV-infected patients, the objective of the present study was to determine the concordance between the energy expenditure values obtained by indirect calorimetry as the gold standard and those obtained by predictive equations elaborated from data for the healthy population: Harris-Benedict, Schofield and Cunningham, and by equations elaborated from data for HIV-infected patients: Melchior (1991-1993).

Methods

The study was conducted at the *Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto* on 32 HIV-infected men under treatment with highly active antiretroviral therapy. Resting energy expenditure was measured by indirect calorimetry and estimated on the basis of measurement of O_2 consumption and CO_2 production.

[1] Article elaborated from the thesis of HS VASSIMON, entitled "Oxidative stress and substrate oxidation in HIV-infected men with lipodystrophy syndrome". Universidade de São Paulo; 2011.

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Results

Statistical analysis revealed weak concordance for the Harris-Benedict (0.38) and Cunningham (0.34) equations and satisfactory concordance for the Schofield equation (0.47). Only the two Melchior equations (1991 and 1993) showed strong concordance with the values obtained by indirect calorimetry (0.63 and 0.66, respectively) and could be used in practice.

Conclusion

The best equations seem to be population-specific, such as the Melchior equations elaborated for HIV-infected patients.

Indexing terms: Calorimetry, indirect. Energy metabolism. HIV.

RESUMO

Objetivo

Frente à necessidade prática da utilização de equações para avaliar gasto energético em portadores do HIV, o presente estudo avaliou a concordância dos valores de gasto energético obtidos pelo padrão ouro de calorimetria indireta com equações preditivas desenvolvidas a partir de população saudável: Harris-Benedict, Schofield e Cunningham e equações desenvolvidas a partir de portadores do HIV: Melchior (1991 a 1993).

Métodos

O estudo foi realizado no Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto, com 32 homens portadores do HIV em terapia antirretroviral de alta potência. O gasto energético de repouso foi medido por calometria indireta e estimado a partir de medida de consumo de O_2 e produção de CO_2.

Resultados

De acordo com análise estatística, a concordância foi fraca para equações de Harris-Benedict (0,38) e Cunningham (0,34) e satisfatória para Schofield (0,47). Apenas as duas equações de Melchior apresentaram forte concordância com valores obtidos por calometria indireta (respectivamente 0,63 e 0,66) e poderiam ser utilizadas na prática.

Conclusão

As melhores equações parecem ser população específica, como as de Melchior, desenvolvidas para portadores do HIV.

Termos de indexação: *Calorimetria indireta. Metabolismo energético. HIV.*

INTRODUCTION

In clinical practice, due to the increased life expectancy of Human Immunodeficiency Virus (HIV) infected patients, it is increasingly common to provide care for asymptomatic HIV-infected individuals who are generally of normal weight with preservation of muscle mass and with possible changes in adipose mass occurring in the presence of lipodystrophy[1]. Changes in body composition occur in the lipodystrophy syndrome, including lipoatrophy (loss of subcutaneous fat in certain parts of the body) and lipohypertrophy (accumulation of visceral fat in certain parts of the body) and metabolic changes such as dyslipidemia and insulin resistance, involving an increased risk for cardiovascular diseases[2]. On this basis, the need for nutritional monitoring becomes essential for this group, and a definition of the energy supply necessary for the maintenance of ideal weight is part of this process. Thus, it is necessary to develop practical tools in order to estimate the energy expenditure of this group of individuals.

Indirect Calorimetry (IC) is one of the most precise methods for the estimate of Resting Energy Expenditure (REE). However, the cost of the equipment needed for these determinations is high, its use requires trained personnel and the procedure is cumbersome, so that IC is more appropriate for scientific research[3]. In clinical practice it is possible to use predictive equations

developed by means of validation studies which evaluate the variables that influence REE and its relationship with the quantitative measurement of this expenditure when evaluated by a more precise method[3]. Predictive equations are useful for a practical and low-cost estimate of REE. These equations are elaborated for specific populations taking into consideration factors such as body composition, age and gender[4].

Many literature reports have compared predictive equations for specific populations to IC in order to determine the best equation for a given group[5-7]. Lopes *et al.*[5] compared the Food and Agriculture Organization/World Health Organization/United Nations University, Harris and Benedict, Henry and Rees and Schofield equations in 30 subjects of both sexes with grade one obesity residing in the city of *Porto Alegre* (RS). According to the results compared to IC values, none of these equations guaranteed application to this population. With the same objective, Fet *et al.*[6] evaluated women ranging from normal weight to obesity and supported the notion that equations for the prediction of REE can induce to errors and seem to be population-specific. In the cited study, better concordance was observed with the equation elaborated from anthropometric measurements than with existing equations in the literature.

Regarding the HIV-infected population, only one article comparing equations and IC was detected in the literature. In a study of 70 HIV-infected men and 16 healthy men, Batterham *et al.*[8] did not detect concordance between predictive equations and values obtained by IC and stated that the changes in body composition may be responsible, at least in part, for this observation.

In view of the practical necessity of using equations, the objective of the preset study was to evaluate the concordance between the resting energy expenditure values obtained by IC, the method considered to be the gold standard, and the estimates obtained using predictive equations.

METHODS

This was an analytical study conducted at the University Hospital, Faculty of Medicine of *Ribeirão Preto* (HC/FMRP). The study was approved by the Research Ethics Committee of the Institution (HCRP nº 1991/2007) and all subjects gave written informed consent to participate. The participants were 32 HIV-infected men on Highly Active Antiretroviral Therapy (HAART) selected at the Acquired Immunodeficiency Syndrome Outpatient Clinic of the Unit Specializing in Infectious-Contagious Diseases (UETDI) of HC/FMRP. Inclusion criteria were age between 18 and 60 years, male gender, stable weight (tolerated variation of 10% in one year), a previous diagnosis of HIV infection, use of HAART for at least 6 months, and T CD4 cell count of more than 200cells/mm^3. Exclusion criteria were severe thyroid or renal, cardiac pulmonary and hepatic changes, signs of opportunistic infections at the time of the study, use of glucocorticoids during the last year, age of less than 18 years or more than 60 years, female gender, patients not on HAART, and T CD4 cell count of less than 200cells/mm^3.

The mean age of the participants was 44±6 years, the time since the diagnosis of HIV infection was 8.5±4 years, and the time of HAART use was 7±4 years. All subjects had undetectable viral load and a T CD4 cell count of 482±224 cells/mm^3. Mean body mass index was 24±3kg/m^2.

IC and REE predictive equations

Resting energy expenditure was estimated using an IC apparatus (Sensor Medics Corporation, Yorba, Linda, CA, USA) by the analysis of consumed Oxygen Volume (VO_2) and produced Carbonic Gas Volume (VCO_2) measured in expired air. The participants were asked to breathe normally while lying down, with a transparent canopy covering their head and chest for 30 minutes. The temperature of the examination room was controlled and constant (23-25°C) and, if a participant entered equilibrium, i.e, if he

presented a <10% fluctuation in minutes of ventilation and oxygen consumption and a <5% fluctuation of the respiratory quotient, the procedure could be stopped after 15 minutes. VO_2 and VCO_2 values permitted the determination of the production of energy which is equal to energy expenditure in a situation of equilibrium, i.e., with no loss or gain in the form of heat or of chemistry. The value was expressed as calories, providing the REE in the fasting situation. The formula of Weir[9] was used to express the results as calories/day: REE (kcal/day)=$5.5VO_2$+$1.76VCO_2$.

The resting energy expenditure values obtained by IC were compared to those of the predictive values listed in Table 1[10-14]. Depending on the equations available in the literature, the results can be reported in different energy units, i.e., calories, kilo joules or mega joules. After the results were obtained, various units were converted to kcal, considering that 1kcal is equivalent to 4.18 joules and 1 mega joule is equivalent to a 1,000 kilo joules.

Dual-energy X-ray Absorptiometry (DXA) was applied to all patients by a trained technician for the determination of the muscle mass values to be included in the equations, using a Hologic apparatus model QDR 4500W®. One of the authors (H. S. Vassimon) determined weight and height. The individuals were fasting, wearing light clothing and no shoes and were asked to remove jackets and coats, if present. Weight was measured with a Filizola® electronic scale of the platform type with a maximum capacity of 300.0kg and precision of 0.1kg. Height was measured with a stadiometer with 0.1cm precision, with the subjects standing with their heels touching, with their arms along the body, their back touching the vertical rod, and positioned in the center of the equipment. Body Mass Index (BMI) (weight in kg divided by height squared) was calculated in order to classify the nutritional status of the participants according to the World Health Organization.

Data were analyzed statistically with the aid of the SAS software, version 9.1. Continuous variables are reported as mean, standard desviation. To achieve the main objective of the study the St. Laurent[15] coefficient was applied to test concordance between values (continuous variables), considering IC as the reference method for comparison. The results of concordance were analyzed according to the classification proposed by Landis & Koch[16], whereby a coefficient of 0.81 to 1.00 indicates almost perfect concordance, a coefficient of 0.61-0.89 indicates strong concordance, a coefficient of 0.41 to 0.60 satisfactory concordance, a coefficient of 0.21 to 0.40 weak concordance, and a coefficient below 0.20 poor concordance. Bland & Altman[17] graphs were obtained as another parameter for the evaluation of concordance of the data.

RESULTS

Table 2 shows the REE results estimated by IC and those obtained mathematically by means of equations. Analysis of the percent value obtained from the predictive equations compared to the total IC value revealed that only the Melchior equations of both 1991 and 1993 approached the real value. Greater discrepancies

Table 1. Predictive equations of resting energy expenditure for HIV-infected individuals.

Author	Formula	Unit
Harris Benedict[11]	66.5 + (13.8 x weight) + (5.0 x height) - 6.8 x age)	kcal/day
Schofield[14]	(0.048 x weight) + 3.653	MJ/day
Cunnigham[10]	(370 + 21.6 x lean mass) x 4.18	kJ/day
Melchior *et al.*[13]	1366 +126 x lean mass	kJ/day
Melchior *et al.*[12]	1379 + 123 x lean mass	kJ/day

Note: Weight in kg; height in cm; age in years; lean mass in kg. KJ: Kilo Joule; MJ: Mega Joule.

Table 2. Energy expenditure measured by indirect calorimetry and estimated with predictive formulas. *Ribeirão Preto* (SP), Brazil, 2008.

	Resting energy expenditure (kcal/day)
Indirect calorimetry	1880 ± 286
Harris-Benedict[11]	1603 ± 179
Schofield[14]	1695 ± 131
Cunningham[10]	1544 ± 149
Melchior *et al.*[13]	1965 ± 208
Melchior *et al.*[12]	1929 ± 203

Note: Data are reported as mean ± standard deviation.

Table 3. Concordance of the energy expenditure values obtained with predictive equations and by indirect calorimetry. *Ribeirão Preto* (SP), Brazil, 2008.

Method	St Laurent coefficient	95%CI	
Harris-Benedict[11]	0.38	0.23	0.52
Schofield[14]	0.47	0.35	0.60
Cunningham[10]	0.34	0.23	0.50
Melchior *et al.*[13]	0.63	0.53	0.71
Melchior *et al.*[12]	0.66	0.57	0.74

Note: Statistical analysis: St. Laurent concordance test. CI: Confidence Inteval de 95%.

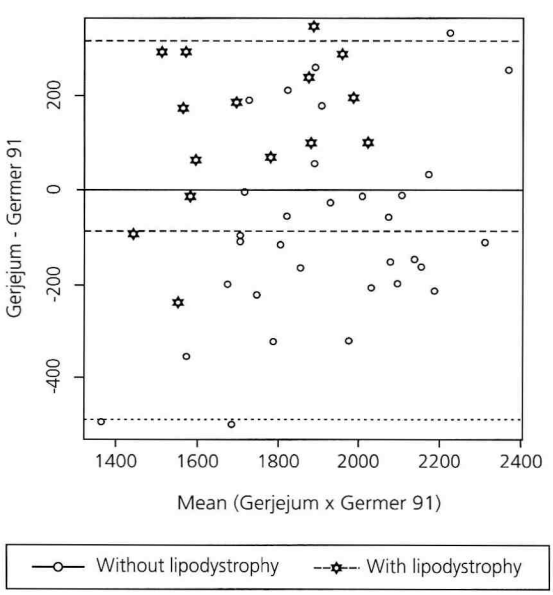

Figure 1. Comparison of the Melchior (1991) equation and of resting energy expenditure values obtained by indirect calorimetry. *Ribeirão Preto* (SP), Brazil, 2008.

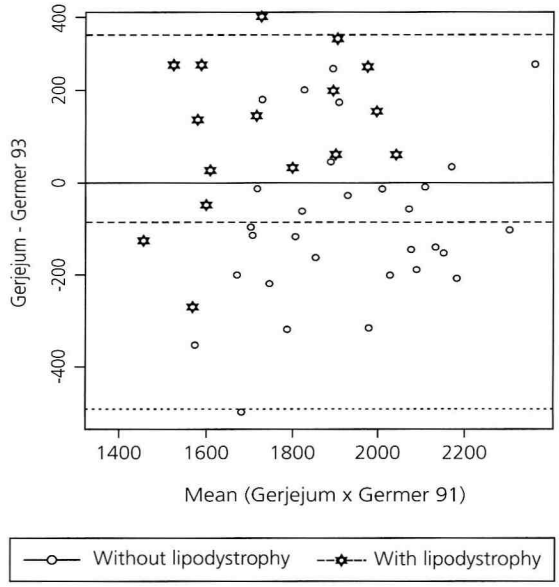

Figure 2. Comparison of the Melchior (1993) equation and of resting energy expenditure values obtained by indirect calorimetry. *Ribeirão Preto* (SP), Brazil, 2008.

were observed between IC and the Cunningham[10] and Harris & Benedict[11] equations.

Table 3 presents the St. Laurent[15] coefficient obtained by comparing the values of the predictive equations to the values obtained by IC. It can be seen that only the REE values calculated with the Melchior equations showed strong concordance with those obtained by IC. Figures 1 and 2 contain graphs comparing the values obtained by the Melchior *et al.*[12,13] equation to those obtained by IC.

DISCUSSION

The Harris & Benedict[11] equation is still one of the main instruments used to evaluate REE in the general population, but the original validated study involved 136 men, 103 women and 94 children of North American origin considered to be healthy. Equations were developed for each gender, including only body weight, height and age as independent variables[11]. Schofield[14] considered jointly the data of 114 studies considered to be scientifically adequate, corresponding to a final sample of 7,173 healthy

individuals (4,809 men and 2,364 women) mostly of European or North American origin. Equations were developed for each gender, including age and body weight as independent variables, without considering height. Cunningham[10] proposed an equation based on a review of studies published since 1980 evaluating REE and total energy expenditure in healthy populations of both genders and pointed out the influence of lean mass as a determinant variable of these values, including only lean mass in the equation.

The central point of the present study was the observation that most of the predictive equations developed for the general population were not sensitive for the estimate of REE in HIV-infected individuals. In this case, the equations underestimate REE compared to the values obtained by IC. Some factors that might explain the lack of concordance of the equations are: a) equations developed based on a healthy population not infected with HIV, b) clinical condition of hypermetabolism presented by the group evaluated, and c) the lack of inclusion of muscle mass as a variable of the equation. An equation is more precise for the specific population for which it was developed and in the case of the present study only two equations used HIV-infected subjects. In contrast, regarding hypermetabolism, this situation was observed both before and after the use of HAART[18,19]. Increased REE in HIV-infected individuals has been described since the onset of the disease but its causes have not been fully clarified. Some of the factors reported in the literature as being involved in this situation of hypermetabolism are: the action of HIV itself, the presence of opportunistic infections, the action of antiretroviral agents, and/or the presence of lipodystrophy syndrome[18,20-22]. A previous study suggested that muscle tissue may be the site responsible for the increased energy expenditure in HIV-infected individuals with lipodystrophy syndrome[23]. With the objective of discriminating the participation of the various sites in REE in HIV-infected patients with lipodystrophy syndrome, Kosmiski *et al.*[23] obtained a metabolic map of adipose tissue, skeletal muscle, brain, bone and residual mass (including intestine, lungs, liver, heart and kidneys) based on DXA values combined with specific metabolic rates for each site described in the literature. Multivariate regression analysis revealed that the estimated metabolic rate was elevated only in the skeletal muscle of HIV-infected patients with lipodystrophy syndrome and not in HIV-infected patients without the syndrome or in healthy controls. Thus, lean mass, which is considered to be the main determinant of REE for the general population, becomes a stronger variable for HIV-infected persons with lipodystrophy syndrome and therefore an important variable to be included in equations for REE estimates.

Within this context, the equations of Melchior *et al.*[12,13] were the only ones showing strong concordance with IC values, having been developed for HIV-infected individuals and considering muscle mass as the variable. The equation published in 1991[13] was based on 50 HIV-infected individuals with a diagnosis of AIDS, with the presence of opportunistic infections or Kaposi sarcoma, with the presence of cachexia and the absence of antiretroviral use. In contrast, the equation published in 1993[12] was elaborated based on 129 malnourished HIV-infected patients with no secondary infections. Only the quantity of lean mass was included in these equations as the independent variable, supporting the importance of this variable for predictive REE equations in HIV-infected individuals. The limiting factor of the Melchior equation would be the question of malnutrition, a situation no longer currently present in most HIV-infected patients on HAART.

CONCLUSION

Of the five equations evaluated, the two equations of Melchior, developed from HIV-infected individuals, were those closest to IC values and could be applied in clinical practice for the estimate of the energy requirements of this group.

The Schofield equation would be an alternative in cases in which the Melchior equation cannot be calculated. Most of the predictive equations of REE in the literature were inadequate for HIV-infected individuals. The best equations seem to be population-specific, such as those of Melchior, developed for HIV-infected individuals.

ACKNOWLEDGMENT

Research supported by *Fundação de Amparo à Pesquisa do Estado de São Paulo* (Grant 2009/12449-7).

COLLABORATORS

HS VASSIMON conceived the study and participated in writing the manuscript; JP MONTEIRO participated in the definition and execution of the project. FJA PAULA and AA MACHADO cooperated with data collection, providing equipment and patient selection. AA JORDÃO participated in orientation and in revision of the text. A KUTSCHENKO was responsible for the statistical analysis.

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Received on: 24/2/2012
Final version on: 17/10/2012
Approved on: 12/11/2012

Produção e potencial agrícolas de alimentos destinados à alimentação escolar em Goiás e no Distrito Federal, na Região Centro-Oeste do Brasil

Agricultural production and potential and foods intended for schools in Goiás *and* Distrito Federal, *located in the Midwest Region of Brazil*

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RESUMO

Objetivo

Caracterizar a produção e o potencial produtivo de hortaliças, frutas e frutos nativos do Cerrado, em Goiás e no Distrito Federal, com vistas à sua inserção na alimentação escolar, conforme a Lei Federal nº 11.947/2009.

Métodos

Foi realizado estudo quantitativo descritivo durante 2009, em cinco mesorregiões de Goiás e no Distrito Federal. Para produção agrícola, consideraram-se dados do Instituto Brasileiro de Geografia e Estatística e estimativas de produção de 2003-2007. Obteve-se o potencial agrícola a partir da temperatura média anual por mesorregião e faixas de temperaturas ótimas por cultura. Os alimentos selecionados foram classificados em escala de produção (menor, média ou alta) e potencial agrícola (ótimo, médio ou baixo).

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Apoio: Fundo Nacional de Desenvolvimento da Educação/Ministério da Educação (FNDE/MEC - TC 922/2010).

Resultados

Foi observado que a produção de frutas e hortaliças concentrou-se no Centro, Leste e Sul do Estado, enquanto o Noroeste e Norte apresentaram menor aproveitamento produtivo. As culturas mais exploradas foram limão, alface, manga, banana e caju. O Distrito Federal teve menor aproveitamento do potencial produtivo em relação a três mesorregiões de Goiás (sem corrigir o índice para área real cultivada). Identificou-se a carência de dados oficiais sobre os frutos do Cerrado.

Conclusão

O estudo mostrou as diferenças regionais quanto à produção de alimentos viáveis à alimentação escolar e também destacou o potencial produtivo a ser alcançado, considerando o desenvolvimento sustentável.

Termos de indexação: Alimentação escolar. Cultivos agrícolas. Legislação. Savana.

ABSTRACT

Objective

This study investigated the production and production potential of vegetables, fruits and native Cerrado *fruits in* Goiás *and* Distrito Federal, *for their inclusion in the school menu as determined by the Law 11.947/2009.*

Methods

A descriptive, quantitative study was done in 2009 in five mesoregions of Goiás *and in* Distrito Federal. *The agricultural production was determined using data from the Brazilian Institute of Geography and Statistics and production estimates from 2003-2007. The estimated agricultural potential was based on the mean annual temperature of each mesoregion and optimal temperature ranges for each culture. The selected foods were classified according to production scale (small, average or high) and agricultural potential (excellent, average or low).*

Results

The production of fruits and vegetables occurred mainly in the central, southern and eastern regions of the state, while the northeast and northern regions were less exploited. The most common cultures were lime, lettuce, mango, banana and cashew. The production potential of the Distrito Federal *was less exploited than that of three mesoregions of* Goiás *(without correcting the index for the actual cultivated area). Also, there is a scarcity of official data on* Cerrado *fruits.*

Conclusion

This study showed the differences in regional production of viable foods for the school menu and highlighted the productive potential of the region, taking sustainable development into account.

Index terms: *School feeding. Agricultural cultivation. Legislation. Savannah.*

INTRODUÇÃO

O modelo agrícola brasileiro tem nos estabelecimentos de Agricultura Familiar os responsáveis por 70% da produção de alimentos no País, razão pela qual são importantes aliados no desenvolvimento local sustentável, na geração de renda/emprego, na redução do êxodo rural e na promoção da Segurança Alimentar e Nutricional[1-3].

Na dimensão da segurança alimentar e nutricional, políticas públicas de estímulo à diversificação da produção, aumento da produtividade e controle dos custos elevados, de promoção de crédito e capitalização dos produtores devem estar associadas à sustentabilidade alimentar[4]. Este conceito incorpora: promoção de formas ambientalmente sustentáveis de ocupação do espaço agrário, valorização das culturas alimentares e incentivo ao desenvolvimento local e regional[5].

Na Região do Planalto Central brasileiro, especificamente Goiás e Distrito Federal, o papel da agricultura familiar deve estar contextualizado em uma perspectiva de desenvolvimento da agricultura, aliada à preservação da biodiversidade

territorial, essencialmente formada pelo Bioma Cerrado. A possibilidade de utilização racional dos frutos do Cerrado, aliada à diversificação da produção de alimentos, são importantes medidas de incentivo ao desenvolvimento econômico, industrial, tecnológico e sustentável da Região[6].

O Programa Nacional de Alimentação Escolar (PNAE) é um espaço de concretização dessa possibilidade, a partir da inserção da agricultura familiar na alimentação escolar, por meio da Lei Federal nº 11.947/2009[7]. Essa conquista representa um marco nas políticas referentes à segurança alimentar e nutricional pelo estímulo à promoção da alimentação adequada e saudável, conforme preconizado pela Política Nacional de Alimentação e Nutrição (PNAN)[8] e o Plano Nacional de Segurança Alimentar e Nutricional (PNSAN)[9].

Este marco legal do PNAE é um indiscutível avanço no campo da alimentação e nutrição. Entretanto, identifica-se como um desafio para a agricultura familiar a diversificação da produção e a inclusão de alimentos regionais na alimentação escolar, o que evidencia a necessidade de aporte técnico capaz de orientar a produção e o extrativismo de alimentos, bem como sua inclusão e oferta na alimentação escolar. Diante disto, este estudo traz uma colaboração diante da escassez de trabalhos nesta área e caracteriza-se como um instrumento de apoio para o desenvolvimento das políticas citadas.

O artigo tem por objetivo caracterizar a produção e potencial produtivo de hortaliças, frutas e frutos nativos do Cerrado em Goiás e no Distrito Federal, com vistas à sua inserção na alimentação escolar.

MÉTODOS

Este estudo integra as ações de pesquisa do Centro Colaborador em Alimentação e Nutrição do Escolar da Universidade Federal de Goiás/Região Centro-Oeste (CECANE UFG/Centro-Oeste) e foi aprovado pelo Comitê de Ética em Pesquisa Humana da UFG, Protocolo nº 055/2009.

A produção agrícola e o potencial produtivo das mesorregiões goianas e Distrito Federal foram sistematizados na forma de um mapa, traduzidos em escalas, cuja construção seguiu divisão do Instituto Brasileiro de Geografia e Estatística (IBGE) para Goiás, compreendendo cinco mesorregiões geográficas: Norte, Noroeste, Leste, Centro e Sul[1]. Inclui-se, ainda, o Distrito Federal, haja vista sua influência econômica, social e política nos municípios circunvizinhos e por situar-se geograficamente neste estado.

A seleção dos produtos considerou as recomendações da PNAN e da Lei Federal nº 11.947/2009, segundo critérios de regionalidade, produção local e benefícios à saúde[7,8]. Além disso, levou em consideração a inserção na alimentação escolar e a possibilidade de produção pela agricultura familiar. Por esta razão, nem todas as hortaliças tradicionais foram mapeadas, uma vez que, no contexto da agricultura familiar em Goiás, nem sempre é viável produzi-las.

Para esta etapa, houve participação da equipe do CECANE UFG/Centro-Oeste, em parceria com a Agência Goiana de Assistência Técnica, Extensão Rural e Pesquisa Agropecuária (Emater - GO) e a Companhia Nacional de Abastecimento - Superintendência Goiás (CONAB-SUREG Goiás), por meio de visita a 11 municípios de Goiás, em 2009, participantes de diagnóstico situacional local sobre a inserção de alimentos da agricultura familiar na alimentação escolar, realizado em 2009, como parte de projeto de extensão cujo foco foi a formação de agricultores familiares.

Realizou-se o levantamento da produção agrícola de cada alimento a partir do banco de dados agregados do IBGE[1]. Para cada um deles, utilizou-se o valor absoluto médio de produção dos anos de 2003-2007 nas mesorregiões goianas e Distrito Federal. Para as culturas com valores de produção ausentes nesta base de dados, utilizaram-se informações obtidas em documentos técnicos da CONAB-SUREG Goiás, Emater-GO e Escola de Agronomia e Engenharia de Alimentos da Universidade Federal de Goiás.

A partir da lista com a produção agrícola média de cada alimento por região, estabeleceu-se um ranqueamento em faixas equidistantes, no qual a quantidade do alimento "x" (produzido pela região maior produtora deste alimento) foi considerada como limite superior da faixa, e a quantidade produzida de alimento "x" (pela região menor produtora do mesmo alimento), o limite inferior da faixa. Desta forma, foram definidas faixas relativas para cada alimento nas cinco mesorregiões de Goiás e no Distrito Federal, obtendo-se uma escala de notas: 1) pequena produção=P; 2) média produção=M; e 3) grande produção=G. No mapa temático, esta escala de produção agrícola foi representada por meio de desenhos dos alimentos nas três dimensões: P, M e G.

Para levantamento dos dados do potencial produtivo das mesorregiões goianas e Distrito Federal, foram consideradas as informações do Atlas Climatológico de Goiás[10] para a construção de um banco de dados com as temperaturas médias mensais e anuais. Uma revisão da literatura permitiu a obtenção das faixas de temperaturas ótimas para cada cultura[10,11].

Para o ranqueamento do potencial produtivo de cada uma das culturas, foram estabelecidas faixas de temperatura do ar que resultaram no estabelecimento de uma escala. Por exemplo, na produção de abóbora, considerando a temperatura adequada para seu desenvolvimento entre 20° e 28°C, a região que apresenta temperaturas médias mensais na faixa central (22°-26°C) tem alto potencial produtivo; a região com temperatura nas faixas secundárias (20° a 21,9°C, ou 26,1°C a 28°C) apresenta médio potencial produtivo; e a região cuja temperatura média encontra-se nas faixas terciárias (<20°C ou >28°C) possui baixo potencial produtivo. O resultado desta análise foi simplificado em três faixas: 3=ótimo; 2=médio e 1=baixo potencial agrícola de produção. Semelhante à produção agrícola, no mapa temático a escala do potencial produtivo foi representada por meio de desenhos dos alimentos nas três dimensões: P, M e G.

A precipitação média de cada mesorregião e o tipo de solo não foram considerados limitantes para o desenvolvimento de nenhuma das culturas mapeadas, sendo considerados apenas no momento da seleção das culturas mais viáveis para a produção no contexto da agricultura familiar em Goiás e no Distrito Federal.

De posse das escalas de produção agrícola e potencial produtivo para cada alimento, avaliou-se o aproveitamento do potencial produtivo de cada região. Neste quesito, a análise considerou: nota do *ranking* do potencial produtivo, subtraindo a nota do *ranking* de produção agrícola. O resultado representou o índice de aproveitamento do potencial produtivo. Nessa perspectiva de análise, quanto menor o índice, maior o aproveitamento do potencial produtivo do alimento na região; por outro lado, quanto maior o índice, pior será o aproveitamento do potencial produtivo desse mesmo alimento na região. Esta análise possibilita índices negativos, por exemplo, na Região Central, onde a maior disponibilidade de recursos e tecnologias faz com que os agricultores produzam além do potencial produtivo estimado.

Os dados foram, ainda, apresentados na forma de um somatório por região de Goiás e Distrito Federal, e também de cada alimento, o que permite avaliar de forma qualitativa o aproveitamento do potencial produtivo de cada região no seu conjunto. Permite, ainda, conhecer quais alimentos são preteridos ou desprezados pelos produtores. Nesta análise, quanto menor o somatório (índice de eficiência por região), melhor será o aproveitamento do potencial produtivo da região.

RESULTADOS

O estudo selecionou 27 alimentos para elaboração do mapeamento da produção agrícola e do potencial produtivo, com as frutas: abacaxi, acerola, banana, caju, limão, mamão, manga, maracujá e tangerina; hortaliças: abóbora, abobrinha, alface, alho, cebola, cheiro-verde, couve, ervilha, mandioca, milho verde, quiabo e vagem;

e os frutos do Cerrado: baru, buriti, cagaita, jatobá, mangaba e pequi.

As informações da produção agrícola dos alimentos selecionados, conforme as cinco mesorregiões goianas e Distrito Federal, apresentadas nas Tabelas 1 e 2, permitiram a construção da escala de produção para Goiás. Observa-se destaque para a alta produção de caju em todas as mesorregiões; mamão em três delas (Noroeste, Centro e Sul) e abacaxi, abóbora, alho, banana, cebola, ervilha, limão, mandioca, manga, maracujá, pequi e tangerina em até duas mesorregiões. Para o Distrito Federal, verificou-se uma elevada produção de abobrinha, alface, limão, manga, maracujá e tangerina. Analisando os volumes totais de todos os alimentos estudados, identifica-se que a produção está concentrada em três regiões: Centro, Leste e Sul.

O estado de Goiás destacou-se pelo elevado potencial produtivo de mandioca, maracujá e vagem para todas as mesorregiões, e em até três delas para abóbora, abobrinha, couve, milho verde e tangerina. O Distrito Federal apresentou elevado potencial produtivo para a cultura da couve. Para os frutos do Cerrado, atribuiu-se a nota três, considerando sua produção agrícola via plantio e extrativismo, uma vez que inexistem dados oficiais para esta produção.

Quanto à eficiência de exploração das culturas, observa-se que as frutíferas do Cerrado como o baru, buriti, cagaita, jatobá e pequi apresentaram um alto potencial produtivo ainda mal explorado, evidente pelo elevado índice de apro-

Tabela 1. *Ranking* de produção das cinco mesorregiões goianas e do Distrito Federal. Média dos dados de 2003 a 2007.

Culturas	Regiões					
	NO	N	C	L	S	DF
Abacaxi	1	2	3	1	2	1
Abóbora	1	1	3	3	2	2
Abobrinha	2	2	2	2	2	3
Acerola	2	2	2	2	2	2
Alface	2	2	2	2	2	3
Alho	1	1	2	3	2	2
Banana	2	1	3	2	2	1
Baru	2	2	2	2	2	1
Buriti	2	2	2	2	2	1
Cagaita	2	2	2	2	2	1
Caju	3	3	3	3	3	1
Cebola	1	2	1	3	2	1
Cheiro-verde	2	2	2	2	2	2
Couve	2	2	2	2	2	2
Ervilha	1	1	1	3	2	1
Jatobá	2	2	2	2	2	1
Limão	1	1	3	3	2	3
Mamão	3	1	3	2	3	1
Mandioca	2	2	3	2	3	1
Manga	1	2	2	2	3	3
Mangaba	2	2	2	2	2	1
Maracujá	1	1	3	2	2	3
Milho verde	2	2	2	2	2	2
Pequi	2	2	2	3	2	1
Quiabo	2	2	2	2	2	2
Tangerina	1	1	3	3	2	3
Vagem	2	2	2	2	2	2

Nota: NO: Noroeste; N: Norte; C: Centro; L: Leste; S: Sul; DF: Distrito Federal.

Fonte: Instituto Brasileiro de Geografia e Estatística/Sistema IBGE de recuperação automática (IBGE/SIDRA), 2009.

Tabela 2. *Ranking* de aproveitamento do potencial produtivo dos alimentos selecionados para mapeamento por mesorregiões de Goiás e Distrito Federal, 2009.

Culturas	Regiões					
	NO	N	C	L	S	DF
Abacaxi	2	2	2	2	2	1
Abóbora	3	3	2	2	2	2
Abobrinha	3	3	2	2	2	2
Acerola	2	2	2	2	2	1
Alface	1	1	1	1	1	2
Alho	1	1	1	2	2	2
Banana	1	1	1	1	1	1
Baru	3	3	3	3	3	3
Buriti	3	3	3	3	3	3
Cagaita	3	3	3	3	3	3
Caju	2	2	2	2	2	1
Cebola	1	1	1	1	2	2
Cheiro-verde	1	1	1	2	2	2
Couve	2	2	3	3	3	3
Ervilha	1	1	1	1	1	2
Jatobá	3	3	3	3	3	3
Limão	1	1	1	1	1	1
Mamão	2	2	2	2	2	2
Mandioca	3	3	3	3	3	2
Manga	2	2	1	1	1	1
Mangaba	3	3	3	3	3	3
Maracujá	3	3	3	3	3	2
Milho verde	3	3	2	2	2	2
Pequi	3	3	3	3	3	3
Quiabo	2	2	2	2	2	2
Tangerina	3	3	2	2	2	2
Vagem	3	3	3	3	3	2

Nota: NO: Noroeste; N: Norte; C: Centro; L: Leste; S: Sul; DF: Distrito Federal.
Fonte: Instituto Brasileiro de Geografia e Estatística/Sistema IBGE de recuperação automática (IBGE/SIDRA), 2009.

veitamento deste potencial na maior parte das regiões. Já as culturas de limão, alface, manga, banana e caju demonstraram ser exploradas com maior eficiência (Tabela 3).

Ao avaliar a eficiência de exploração do potencial produtivo, observaram-se, inclusive, valores negativos, que demonstram produção superior ao potencial produtivo - por exemplo, a banana, na Região Central de Goiás.

Construção do mapa de produção agrícola e potencial produtivo

Para a elaboração do mapa, estudou-se a relação entre a produção e o potencial agrícola de cada uma das 27 culturas identificadas. Estas informações geraram a apresentação gráfica de um mapa (disponível em: http://cecane-ufg.blogspot.com.br/), com dimensões de 320x460mm, dobrável, incluindo legenda, figuras dos alimentos produzidos no interior das mesorregiões goianas e Distrito Federal e o potencial produtivo, representado pelas figuras dos alimentos inseridas em quadros superpostos no mesmo espaço definido. Trata-se de material inédito elaborado pelo CECANE UFG/Centro-Oeste, com foco na alimentação escolar, com informações relacionadas ao bioma Cerrado, ao cultivo de alimentos (técnicas de produção, boas práticas agrícolas e agroecologia).

Tabela 3. Índice de aproveitamento do potencial produtivo dos alimentos selecionados para mapeamento por mesorregiões de Goiás e Distrito Federal. CECANE-UFG, 2009.

Culturas	Regiões						Somatório
	NO	N	C	L	S	DF	
Abacaxi	1	0	-1	1	0	0	1
Abóbora	2	2	-1	-1	0	0	2
Abobrinha	1	1	0	0	0	-1	1
Acerola	0	0	0	0	0	-1	-1
Alface	-1	-1	-1	-1	-1	-1	-6
Alho	0	0	-1	-1	0	0	-2
Banana	-1	0	-2	-1	-1	0	-5
Baru	1	1	1	1	1	2	7
Buriti	1	1	1	1	1	2	7
Cagaita	1	1	1	1	1	2	7
Caju	-1	-1	-1	-1	-1	0	-5
Cebola	0	-1	0	-2	0	1	-2
Cheiro-verde	-1	-1	-1	0	0	0	-3
Couve	0	0	1	1	1	1	4
Ervilha	0	0	0	-2	-1	1	-2
Jatobá	1	1	1	1	1	2	7
Limão	0	0	-2	-2	-1	-2	-7
Mamão	-1	1	-1	0	-1	1	-1
Mandioca	1	1	0	1	0	1	4
Manga	1	0	-1	-1	-2	-2	-5
Mangaba	1	1	1	1	1	2	7
Maracujá	2	2	0	1	1	-1	5
Milho verde	1	1	0	0	0	0	2
Pequi	1	1	1	0	1	2	6
Quiabo	0	0	0	0	0	0	0
Tangerina	2	2	-1	-1	0	-1	1
Vagem	1	1	1	1	1	0	5
Somatório	13	13	-5	-3	1	8	

Nota: NO: Noroeste; N: Norte; C: Centro; L: Leste; S: Sul; DF: Distrito Federal.

Fonte: Instituto Brasileiro de Geografia e Estatística/Sistema IBGE de recuperação automática (IBGE/SIDRA), 2009.

DISCUSSÃO

A opção por um mapa teve como objetivo traduzir, de forma simples e direta, informações que devem estar ao alcance dos produtores destes alimentos e dos gestores do PNAE, pautando, assim, a oferta e a demanda dos mesmos. Além disso, este mapa será uma ferramenta no trabalho do nutricionista, ao oportunizar um panorama dos produtos locais para a elaboração do cardápio - passo inicial para a efetivação da compra de alimentos provenientes da agricultura familiar.

Comparando-se as mesorregiões quanto ao potencial produtivo (Tabela 3), observou-se que o Noroeste e o Norte goiano têm menor aproveitamento deste potencial, informação que reitera o diagnóstico situacional local (relatório técnico disponível em: http://cecane-ufg.blogspot.com.br/), que apontou a carência em assistência técnica e acesso a linhas de crédito para a produção de alimentos. Já a Região Central apresenta aproveitamento mais eficiente de seu potencial produtivo, o que é comprovado pela maior movimentação financeira e aporte técnico na região.

O Distrito Federal apresentou um menor aproveitamento do potencial produtivo em relação a três mesorregiões goianas; contudo, o método de avaliação não considerou diretamente as dimensões geográficas do território e a pro-

porção coberta pela zona urbana, o que o colocaria com um maior aproveitamento de seu potencial de produção.

O potencial produtivo do limão, alface, banana, manga e caju demonstrou serem culturas exploradas com maior eficiência. Já algumas frutíferas do Cerrado mostraram um alto potencial de produção ainda pouco explorado, com destaque para o baru, buriti, cagaita, jatobá e pequi (Tabela 3), cuja utilização tem sido demonstrada em diversos estudos[12-15].

De modo geral, as frutíferas nativas do Cerrado são mal exploradas comercialmente, e grande parte dos produtos existentes no mercado é oriunda de extração sazonal, sendo que não há nenhum tipo de planejamento produtivo ou estabilidade de oferta[15]. Os frutos do Cerrado apresentam grande potencial produtivo e valor nutricional e comercial para utilização na alimentação escolar; entretanto, são subaproveitados, assim como alguns alimentos de produção agrícola regional.

Neste sentido, faz-se necessária a articulação entre as esferas governamentais e a realização de atividades de formação com os produtores rurais locais, devido à necessidade de maior aporte técnico quanto à produção e comercialização de alimentos, além da formulação de políticas públicas que promovam melhor aproveitamento da produção agrícola regional.

Este estudo teve como limitações a obtenção de informações secundárias, por meio de fontes governamentais, para ampliar a comparação e discussão dos resultados, visto sua inexistência ou falta de atualização. As Centrais de Abastecimento (CEASA) possuem informações sobre a comercialização, contudo sem incluir a produção consumida localmente.

CONCLUSÃO

O mapeamento possibilitou caracterizar a produção e o potencial agrícola dos alimentos selecionados provenientes da agricultura familiar das cinco mesorregiões do estado de Goiás e do Distrito Federal. A síntese dos resultados, sob a forma de mapa, permite aos produtores e técnicos não somente selecionar as culturas que podem ser mais bem exploradas em cada região, como também os alimentos que possuem sua produção limitada por fatores ambientais.

As Regiões Norte e Noroeste do estado de Goiás apresentam a menor taxa de aproveitamento do potencial produtivo, enquanto a Região Central apresenta o maior. Para o Distrito Federal, as limitações no método de avaliação o levaram a apresentar um aproveitamento do potencial produtivo menor que outras três mesorregiões goianas; contudo, para o mapeamento não foram consideradas as dimensões geográficas do território e a proporção coberta pela zona urbana.

Dentre as culturas avaliadas, observou-se que os alimentos com melhor aproveitamento do potencial produtivo foram: limão, alface, manga, caju e banana. Já para os frutos do Cerrado, dentre eles, baru, buriti, cagaita, jatobá e pequi, percebeu-se baixo aproveitamento do potencial produtivo.

A valorização dos alimentos regionais (frutos do Cerrado e demais alimentos consumidos e produzidos na região) para elaboração do cardápio da alimentação escolar possibilita a geração de renda, promovendo a sustentabilidade, práticas alimentares mais saudáveis e respeito à identidade cultural e alimentar das comunidades. É possível, também, que este incentivo promova formas de uso mais sustentáveis dos recursos naturais do bioma Cerrado, evitando as práticas comuns no extrativismo predatório.

AGRADECIMENTOS

Ao Fundo Nacional de Desenvolvimento da Educação/Ministério da Educação e Cultura, pelo financiamento, e ao Prof. Dr. João Gaspar Farias, da Escola de Agronomia da Universidade Federal de Goiás, pela assessoria técnica.

COLABORADORES

Todos os autores participaram de todas as etapas de elaboração do manuscrito: concepção, desenho, análise e interpretação dos resultados.

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Recebido em: 18/11/2011
Versão final em: 10/4/2012
Aprovado em: 30/4/2012

INSTRUÇÕES AOS AUTORES

Escopo e política

A **Revista de Nutrição/*Brazilian Journal of Nutrition*** é um periódico especializado que publica artigos que contribuem para o estudo da Nutrição em suas diversas subáreas e interfaces. Com periodicidade bimestral, está aberta a contribuições da comunidade científica nacional e internacional.

Os manuscritos podem ser rejeitados sem comentários detalhados após análise inicial, por pelo menos dois editores da Revista de Nutrição, se os artigos forem considerados inadequados ou de prioridade científica insuficiente para publicação na Revista.

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Os autores devem indicar a categoria do artigo e a área temática, a saber: alimentação e ciências sociais, avaliação nutricional, bioquímica nutricional, dietética, educação nutricional, epidemiologia e estatística, micronutrientes, nutrição clínica, nutrição experimental, nutrição e geriatria, nutrição materno-infantil, nutrição em produção de refeições, políticas de alimentação e nutrição e saúde coletiva.

Pesquisas envolvendo seres vivos

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A indicação dos nomes dos autores logo abaixo do título do artigo é limitada a 6. O crédito de autoria deverá ser baseado em contribuições substanciais, tais como concepção e desenho, ou análise e interpretação dos dados. Não se justifica a inclusão de nomes de autores cuja contribuição não se enquadre nos critérios acima.

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Caso haja utilização de figuras ou tabelas publicadas em outras fontes, deve-se anexar documento que ateste a permissão para seu uso.

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O texto deverá contemplar o número de palavras de acordo com a categoria do artigo. As folhas deverão ter numeração personalizada desde a folha de rosto (que deverá apresentar o número 1). O papel deverá ser de tamanho A4, com formatação de margens superior e inferior (no mínimo 2,5cm), esquerda e direita (no mínimo 3cm).

Os artigos devem ter, aproximadamente, 30 referências, exceto no caso de artigos de revisão, que podem apresentar em torno de 50. Sempre que uma referência possuir o número de *Digital Object Identifier* (DOI), este deve ser informado.

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a) título completo - deve ser conciso, evitando excesso de palavras, como "avaliação do....", "considerações acerca de..." 'estudo exploratório....";

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Os artigos submetidos em inglês deverão vir acompanhados de resumo em português, além do *abstract* em inglês.

Para os artigos originais, os resumos devem ser estruturados destacando objetivos, métodos básicos adotados, informação sobre o local, população e amostragem da pesquisa, resultados e conclusões mais relevantes, considerando os objetivos do trabalho, e indicando formas de continuidade do estudo.

Para as demais categorias, o formato dos resumos deve ser o narrativo, mas com as mesmas informações.

O texto não deve conter citações e abreviaturas. Destacar no mínimo três e no máximo seis termos de indexação, utilizando os descritores em Ciência da Saúde - DeCS - da Bireme <http://decs.bvs.br>.

Texto: com exceção dos manuscritos apresentados como Revisão, Comunicação, Nota Científica e Ensaio, os trabalhos deverão seguir a estrutura formal para trabalhos científicos:

Introdução: deve conter revisão da literatura atualizada e pertinente ao tema, adequada à apresentação do problema, e que destaque sua relevância. Não deve ser extensa, a não ser em manuscritos submetidos como Artigo de Revisão.

Métodos: deve conter descrição clara e sucinta do método empregado, acompanhada da correspondente citação bibliográfica, incluindo: procedimentos adotados; universo e amostra; instrumentos de medida e, se aplicável, método de validação; tratamento estatístico.

Em relação à análise estatística, os autores devem demonstrar que os procedimentos utilizados foram não somente apropriados para testar as hipóteses do estudo, mas também corretamente interpretados. Os níveis de significância estatística (ex. $p<0,05$; $p<0,01$; $p<0,001$) devem ser mencionados.

Informar que a pesquisa foi aprovada por Comitê de Ética credenciado junto ao Conselho Nacional de Saúde e fornecer o número do processo.

Ao relatar experimentos com animais, indicar se as diretrizes de conselhos de pesquisa institucionais ou nacionais - ou se qualquer lei nacional relativa aos cuidados e ao uso de animais de laboratório - foram seguidas.

Resultados: sempre que possível, os resultados devem ser apresentados em tabelas ou figuras, elaboradas de forma a serem auto-explicativas e com análise estatística. Evitar repetir dados no texto.

Tabelas, quadros e figuras devem ser limitados a cinco no conjunto e numerados consecutiva e independentemente com algarismos arábicos, de acordo com a ordem de menção dos dados, e devem vir em folhas individuais e separadas, com indicação de sua localização no texto. **É imprescindível a informação do local e ano do estudo**. A cada um se deve atribuir um título breve. Os quadros e tabelas terão as bordas laterais abertas.

O(s) autor(es) se responsabiliza(m) pela qualidade das figuras (desenhos, ilustrações, tabelas, quadros e gráficos), que deverão ser elaboradas em tamanhos de uma ou duas colunas (7 e 15cm, respectivamente); **não é permitido o formato paisagem**. Figuras digitalizadas deverão ter extensão jpeg e resolução mínima de 400 dpi.

Gráficos e desenhos deverão ser gerados em programas de desenho vetorial (*Microsoft Excel*, *CorelDraw*, *Adobe Illustrator* etc.), acompanhados de seus parâmetros quantitativos, em forma de tabela e com nome de todas as variáveis.

A publicação de imagens coloridas, após avaliação da viabilidade técnica de sua reprodução, será custeada pelo(s) autor(es). Em caso de manifestação de interesse por parte do(s) autor(es), a Revista de Nutrição providen-

ciará um orçamento dos custos envolvidos, que poderão variar de acordo com o número de imagens, sua distribuição em páginas diferentes e a publicação concomitante de material em cores por parte de outro(s) autor(es).

Uma vez apresentado ao(s) autor(es) o orçamento dos custos correspondentes ao material de seu interesse, este(s) deverá(ão) efetuar depósito bancário. As informações para o depósito serão fornecidas oportunamente.

Discussão: deve explorar, adequada e objetivamente, os resultados, discutidos à luz de outras observações já registradas na literatura.

Conclusão: apresentar as conclusões relevantes, considerando os objetivos do trabalho, e indicar formas de continuidade do estudo. **Não serão aceitas citações bibliográficas nesta seção**.

Agradecimentos: podem ser registrados agradecimentos, em parágrafo não superior a três linhas, dirigidos a instituições ou indivíduos que prestaram efetiva colaboração para o trabalho.

Anexos: deverão ser incluídos apenas quando imprescindíveis à compreensão do texto. Caberá aos editores julgar a necessidade de sua publicação.

Abreviaturas e siglas: deverão ser utilizadas de forma padronizada, restringindo-se apenas àquelas usadas convencionalmente ou sancionadas pelo uso, acompanhadas do significado, por extenso, quando da primeira citação no texto. Não devem ser usadas no título e no resumo.

Referências de acordo com o estilo *Vancouver*

Referências: devem ser numeradas consecutivamente, seguindo a ordem em que foram mencionadas pela primeira vez no texto, conforme o estilo *Vancouver*.

Nas referências com dois até o limite de seis autores, citam-se todos os autores; acima de seis autores, citam-se os seis primeiros autores, seguido de *et al*.

As abreviaturas dos títulos dos periódicos citados deverão estar de acordo com o *Index Medicus*.

Não serão aceitas citações/referências de **monografias** de conclusão de curso de graduação, **de trabalhos** de Congressos, Simpósios, *Workshops*, Encontros, entre outros, e de **textos não publicados** (aulas, entre outros).

Se um trabalho não publicado, de autoria de um dos autores do manuscrito, for citado (ou seja, um artigo *in press*), será necessário incluir a carta de aceitação da revista que publicará o referido artigo.

Se dados não publicados obtidos por outros pesquisadores forem citados pelo manuscrito, será necessário incluir uma carta de autorização, do uso dos mesmos por seus autores.

Citações bibliográficas no texto: deverão ser expostas em ordem numérica, em algarismos arábicos, meia linha acima e após a citação, e devem constar da lista de referências. Se forem dois autores, citam-se ambos ligados pelo "&"; se forem mais de dois, cita-se o primeiro autor, seguido da expressão *et al*.

A exatidão e a adequação das referências a trabalhos que tenham sido consultados e mencionados no texto do artigo são de responsabilidade do autor. Todos os autores cujos trabalhos forem citados no texto deverão ser listados na seção de Referências.

Exemplos

Artigo com um autor

Burlandy L. A construção da política de segurança alimentar e nutricional no Brasil: estratégias e desafios para a promoção da intersetorialidade no âmbito federal de governo. Ciênc Saúde Coletiva. 2009; 14(3):851-60. doi: 10.1590/S1413-81232009000300020.

Artigo com mais de seis autores

Oliveira JS, Lira PIC, Veras ICL, Maia SR, Lemos MCC, Andrade SLL, *et al*. Estado nutricional e insegurança alimentar de adolescentes e adultos em duas localidades de baixo índice de desenvolvimento humano. Rev Nutr. 2009; 22(4): 453-66. doi: 10.1590/S1415-52732009000400002.

Livro

Alberts B, Lewis J, Raff MC. Biologia molecular da célula. 5ª ed. Porto Alegre: Artmed; 2010.

Capítulos de livros

Aciolly E. Banco de leite. In Aciolly E. Nutrição em obstetrícia e pediatria. 2ª ed. Rio de Janeiro: Guanabara Koogan; 2009. Unidade 4.

Dissertações e teses

Duran ACFL. Qualidade da dieta de adultos vivendo com HIV/AIDS e seus fatores associados [mestrado]. São Paulo: Universidade de São Paulo; 2009.

Artigo em suporte eletrônico

Sichieri R, Moura EC. Análise multinível das variações no índice de massa corporal entre adultos, Brasil, 2006. Rev Saúde Pública. 2009 [acesso 2009 dez 18]; 43(suppl.2): 90-7. Disponível em: <http://www.scielo.br/scielo.php?

script=sci_arttext&pid=S0034-89102009000900120012&lng=pt&nrm=iso>. doi: 10.1590/S0034-89102009000900012.

Livro em suporte eletrônico

Brasil. Alimentação saudável para pessoa idosa: um manual para o profissional da saúde. Brasília: Ministério da Saúde; 2009 [acesso 2010 jan 13]. Disponível em: <http://200.18.252.57/services/e-books/alimentacao_saudavel_idosa_profissionais_saude.pdf>.

Capítulo de livro em suporte eletrônico

Emergency contraceptive pills (ECPs). In World Health Organization. Medical eligibility criteria for contraceptive use. 4th ed. Geneva: WHO; 2009 [cited 2010 Jan 14]. Available from: <http://whqlibdoc.who.int/publications/2009/9789241563888_eng.pdf>.

Texto em formato eletrônico

Sociedade Brasileira de Nutrição Parental e Enteral. Assuntos de interesse do farmacêutico atuante na terapia nutricional. 2008/2009 [acesso 2010 jan 14]. Disponível em: <http://www.sbnpe.com.br/ctdpg.php?pg=13&ct=A>.

Para outros exemplos recomendamos consultar as normas do *Committee of Medical Journals Editors* (Grupo Vancouver) <http://www.icmje.org>.

Lista de checagem

- Declaração de responsabilidade e transferência de direitos autorais assinada por cada autor.

- Verificar se o texto, incluindo resumos, tabelas e referências, está reproduzido com letras fonte *Arial,* corpo 11 e entrelinhas 1,5 e com formatação de margens superior e inferior (no mínimo 2,5cm), esquerda e direita (no mínimo 3cm).

- Indicação da categoria e área temática do artigo.

- Verificar se estão completas as informações de legendas das figuras e tabelas.

- Preparar página de rosto com as informações solicitadas.

- Incluir o nome de agências financiadoras e o número do processo.

- Indicar se o artigo é baseado em tese/dissertação, colocando o título, o nome da instituição, o ano de defesa.

- Incluir título do manuscrito, em português e em inglês.

- Incluir título abreviado (*short title*), com 40 caracteres, para fins de legenda em todas as páginas.

- Incluir resumos estruturados para trabalhos submetidos na categoria de originais e narrativos para manuscritos submetidos nas demais categorias, com um número de 150 palavras e no máximo 250 palavras nos dois idiomas, português e inglês, ou em espanhol, nos casos em que se aplique, com termos de indexação.

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- Incluir permissão de editores para reprodução de figuras ou tabelas publicadas.

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Documentos

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GUIDE FOR AUTHORS

Scope and policy

The **Brazilian Journal of Nutrition** is a specialized periodical that publishes articles that contribute to the study of Nutrition in its many sub-areas and interfaces. It is published bimonthly and open to contributions of the national and international scientific communities.

Submitted manuscripts may be rejected without detailed comments after initial review by at least two **Brazilian Journal of Nutrition** editors if the manuscripts are considered inappropriate or of insufficient scientific priority for publication in the Journal.

The Board of Editors does not assume responsability for concepts and illustrations emitted in signed articles.

Article category

The Journal accepts unpublished articles in Portuguese, Spanish or English, with title, abstract and keywords in the original language and in English, in the following categories:

Original: contributions that aim to disclose the results of unpublished researches, taking into account the relevance of the theme, the scope and the knowledge generated for the research area (maximum limit of 5 thousand words).

Special: invited articles on current themes (maximum limit of 6 thousand words).

Review (by invitation): synthesis of the knowledge available on a given theme, based on analysis and interpretation of the pertinent literature, aiming to make a critical and comparative analysis of the works in the area and discuss the methodological limitations and its scope. It also allows the indication of perspectives of continuing studies in that line of research (maximum limit of 6 thousand words). There will be a maximum of two reviews per issue.

Communication: information reported on relevant themes and based on recent research, whose objective is to subsidize the work of professionals who work in the field, serving as a presentation or update on the theme (maximum limit of 4 thousand words).

Scientific note: partial unpublished data of an ongoing research (maximum limit of 4 thousand words).

Essay: works that can bring reflection and discussion of a subject that generates questioning and hypotheses for future research (maximum limit of 5 thousand words).

Thematic Section (by invitation): section whose aim is to publish 2 or 3 coordinated articles from different authors covering a theme of current interest (maximum of 10 thousand words).

Article's category and subject area

Authors should indicate the article's category and subject area, namely: food and social sciences, nutritional assessment, nutritional biochemistry, nutrition, nutrition education, epidemiology and statistics, micronutrients, clinical nutrition, experimental nutrition, nutrition and geriatrics, nutrition, maternal and infant nutrition in meal production, food and nutrition policies and health.

Research involving living beings

Results of research involving human beings and animals, must contain a copy of the Research Ethics Committee approval.

Registration of Clinical Trials

Articles with results of clinical researches must present an identification number in one of the Register of Clinical Trials validated by criteria established the the World Health Organization (WHO) and International Committee of Medical Journal Editors (ICMJE), whose addresses are available at the ICMJE site. The identification number must be included at the end of the abstract.

The authors must indicate three possible reviewers for the manuscript. Alternatively, the authors may indicate three reviewers to whom they do not want their manuscript to be sent.

Editorial procedures

Authorship

The list of authors, included below the title, should be limited to 6. The authorship credit must be based on substantial contributions, such as conception and design, or analysis and interpretation of the data. The inclusion of authors whose contribution does not include the criteria mentioned above is not justified.

The manuscripts must explicitly contain in the identification page the contribution of each one of the authors.

Manuscript judgment process

All manuscripts will only start undergoing the publication process if they are in agreement with the Instructions to the Authors. If not, **they will be returned for the authors to make the appropriate adjustments**, include a letter or other documents that may be necessary.

It is strongly recommended that the author(s) seek professional language services (reviewers and/or translators certified in the Portuguese or English languages) before they submit articles that may have semantic, grammar, syntactic, morphological, idiomatic or stylistic mistakes. The authors must also avoid using the first person of the singular, "my study...," or the first person of the plural "we noticed...," since scientific texts ask for an impersonal, non-judgmental discourse.

Articles with any of the mistakes mentioned above **will be returned even before they are submitted to assessment** regarding the merit of the work and the convenience of its publication.

Pre-evaluation: Scientific Editors evaluate manuscripts according to their originality, application, academic quality and relevance in nutrition.

Once the articles are approved in this phase, they will be sent to *ad hoc* peer reviewers selected by the editors. Each manuscript will be sent to two reviewers of known competence in the selected theme. One of them may be chosen by the authors' indicatiton. If there is disagreement, the manuscript will be sent to a third reviewer.

The entire manuscript process will end on the second version, which will be final.

The peer review process used is the blind review, where the identity of the authors and the reviewers is not mutually known. Thus the authors must do everything possible to avoid the identification of the authors of the manuscript.

The opinions of the reviewers are one of the following: a) approved; b) new analysis needed; c) refused. The authors will always be informed of the reviewers' opinion.

Reviews are examined by the Editors who will recommend or not the manuscript's approval by the Scientific Editor.

Rejected manuscripts that can potentially be reworked can be resubmitted as a new article and will undergo a new peer review process.

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If there are conflicts of interest regarding the reviewers, the Editorial Committee will send the manuscript to another *ad hoc* reviewer.

Accepted manuscripts: accepted manuscripts may return to the authors for the approval of changes done in the editorial and normalization process, according to the Journal's style.

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Preparation of the manuscript

Submission of works

Manuscripts need to be accompanied by a letter signed by all the authors describing the type of work and the thematic area, a declaration that the manuscript is being submitted only to the Journal of Nutrition, an agreement to transfer the copy rights and a letter stating the main contribution of the study to the area.

If the manuscript contains figures or tables that have already been published elsewhere, a document given by the original publisher authorizing their use must be included.

The manuscripts need to be sent to the Editorial Center of the Journal, to the site <http://www.scielo.br/rn> with a line spacing of 1.5, font Arial 11. The file must be in Microsoft Word (doc) format version 97-2003 or better.

It is essential that the body of the article **does not contain any information that may identify the author(s)**, including, for example, reference to previous works of the author(s) or mention of the institution where the work was done.

The articles should have approximately 30 references, except for review articles, which may contain about 50 references. A reference must always contain the Digital Object Identifier (DOI).

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Please use a color font (preferably blue) or underline all the changes made to the text, Include a letter to the editor confirming your interest in publishing your article in this Journal and state which changes were made in the manuscript. If the authors disagree with the opinion of the reviewers, they should present arguments that justify their position. The title and the code of the manuscript must be specified.

Title page must contain

a) full title - must be concise, avoiding excess wording, such as "assessment of...," "considerations on...," "exploratory study...";

b) short title with up to 40 characters (including spaces) in Portuguese (or Spanish) and English;

c) full name of all the authors, indicating the institutional affiliation of each one of them. Only one title

and affiliation will be accepted per author. The author(s) should therefore choose among their titles and institutional affiliations those that they deem more important;

d) all data of the titles and affiliations must not contain any abbreviations;

e) provide the full address of all the universities to which the authors are affiliated;

f) provide the full address for correspondence of the main author for the editorial procedures, including fax and telephone numbers and e-mail address.

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Abstract: all articles submitted in Portuguese or Spanish must contain an abstract in the original language and in English, with at least 150 words and at most 250 words.

The articles submitted in English must contain an abstract in Portuguese in addition to the abstract in English.

Original articles must contain structured abstracts containing objectives, basic research methods, information regarding study location, population and sample, results and most relevant conclusions, considering the objectives of the work and indicating ways of continuing the study.

The other categories should contain a narrative abstract but with the same information.

The text should not contain citations and abbreviations. Provide from 3 to 6 keywords using Bireme's Health Sciences descriptors. <http://decs.bvs.br>.

Text: except for the manuscripts presented as Review, Communication, Scientific Note and Assay, the works must follow the formal structure for scientific works:

Introduction: must contain a current literature review pertinent to the theme and appropriate to the presentation of the problem, also emphasizing its relevance. It should not be extensive except for manuscripts submitted as Review Articles.

Methods: must contain a clear and brief description of the method, including the corresponding literature: procedures, universe and sample, measurement tools, and validation method and statistical treatment when applicable.

Regarding the statistical analysis, the authors should demonstrate that the procedures were not only appropriate to test the hypotheses of the study but were also interpreted correctly. The statistical significance levels (e.g. $p<0.05$; $p<0.01$; $p<0.001$) must be mentioned.

Inform that the research was approved by an Ethics Committee certified by the National Council of Health and provide the number of the protocol.

When experiments with animals are reported, indicate if the guidelines of the institutional or national research councils - or if any national law regarding the care and use of laboratory animals - were followed.

Results: whenever possible, the results must be presented in self-explanatory tables and figures and contain statistical analysis. Avoid repeating the data in the text.

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The author(s) are responsible for the quality of the figures (drawings, illustrations, tables and graphs) that should the large enough to fit one or two columns (7 and 15cm respectively); **the landscape format is not accepted**. Figures should be in jpeg format and have a minimum resolution of 400 dpi.

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The publication of color images will be paid by the author(s) once the technical viability of their reproduction is verified. If the authors are interested, the Journal will provide the costs which will vary according to the number of images, their distribution in different pages, and the concomitant publication of color material by other author(s).

Once the authors are informed of such costs, they are expected to pay via wire transfer. The information for the wire transfer will be given at the appropriate time.

Discussion: the discussion must properly and objectively explore the results under the light of other observations already published in the literature.

Conclusion: present the relevant conclusions, considering the objectives of the work, and indicate ways to continue the study. **Literature citations will not be accepted in this section**.

Acknowledgments: may be made in a paragraph no bigger than three lines to institutions or individuals who actually collaborated with the work.

Attachments: should be included only when they are essential to the understanding of the text. The editors will decide upon the need of their publication.

Abbreviations and acronyms: should be used in a standardized fashion and restricted to those used conventionally or sanctioned by use, followed by the meaning in full when it is first mentioned in the text. They must not be used in the title and abstract.

References must follow the Vancouver style

References: must be numbered consecutively according to the order that they were first mentioned in the text, according to the Vancouver style.

All authors should be cited in references with two to six authors; if more than six authors, only the first six should be cited followed by *et al*.

The abbreviations of cited journals should be in agreement with the Index Medicus.

Citations/references of **undergraduate monographs, works** presented in congresses, symposiums, workshops, meetings, among others, and **unpublished texts** (classes among others) **will not be accepted**.

If the unpublished work of one of the authors of the manuscript is cited (that is, an in press article), it is necessary to include the letter of acceptance of the journal that will publish the article.

If unpublished data obtained by other researchers are cited in the manuscript, it is necessary to include a letter authorizing the use of such data by the original authors.

Literature citations in the text should be in numerical order, Arabic numerals, placed after the citation in superscript, and included in the references. If two authors are mentioned, both are cited using the "&" in between; if more than two authors, the first author is cited followed by the *et al*. expression.

The accuracy and appropriateness of references to works that have been consulted and mentioned in the text of the article are of the author(s) responsibility. All authors whose works were cited in the text should be listed in the References section.

Examples

Article with one author

Burlandy L. A construção da política de segurança alimentar e nutricional no Brasil: estratégias e desafios para a promoção da intersetorialidade no âmbito federal de governo. Ciênc Saúde Coletiva. 2009; 14(3):851-60. doi: 10.1590/S1413-81232009000300020.

Article with more than six authors

Oliveira JS, Lira PIC, Veras ICL, Maia SR, Lemos MCC, Andrade SLL, *et al*. Estado nutricional e insegurança alimentar de adolescentes e adultos em duas localidades de baixo índice de desenvolvimento humano. Rev Nutr. 2009; 22(4):453-66. doi: 10.1590/S1415-52732009000400002.

Book

Alberts B, Lewis J, Raff MC. Biologia molecular da célula. 5ª ed. Porto Alegre: Artmed; 2010.

Book chapters

Aciolly E. Banco de leite. In Aciolly E. Nutrição em obstetrícia e pediatria. 2ª ed. Rio de Janeiro: Guanabara Koogan; 2009. Unidade 4.

Dissertations and theses

Duran ACFL. Qualidade da dieta de adultos vivendo com HIV/AIDS e seus fatores associados [mestrado]. São Paulo: Universidade de São Paulo; 2009.

Article in electronic media

Sichieri R, Moura EC. Análise multinível das variações no índice de massa corporal entre adultos, Brasil, 2006. Rev Saúde Pública. 2009 [acesso 2009 dez 18]; 43(suppl.2):90-7. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102009000900012&lng=pt&nrm=iso>. doi: 10.1590/S0034-8910 2009000900012.

Electronic book

Brasil. Alimentação saudável para pessoa idosa: um manual para o profissional da saúde. Brasília: Ministério da Saúde; 2009 [acesso 2010 jan 13]. Disponível em: <http://200.18.252.57/services/e-books/alimentacao_saudavel_idosa_profissionais_saude.pdf>.

Electronic book chapters

Emergency contraceptive pills (ECPs). In World Health Organization. Medical eligibility criteria for contraceptive use. 4th ed. Geneva: WHO; 2009 [cited 2010 Jan 14]. Available from: <http://whqlibdoc.who.int/publications/2009/9789241563888_eng.pdf>.

Electronic texts

Sociedade Brasileira de Nutrição Parental e Enteral. Assuntos de interesse do farmacêutico atuante na terapia nutricional. 2008/2009 [acesso 2010 jan 14]. Disponível em: <http://www.sbnpe.com.br/ctdpg.php?pg=13&ct=A>.

For other examples, please see the norms of the Committee of Medical Journals Editors (Vancouver Group) <http://www.icmje.org>.

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- Declaration of responsibility and transfer of copyrights signed by each author.

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- Include the name of the sponsors and the number of the process.

- Indicate if the article is based on a thesis/dissertation, and include its title, name of institution and year of defense.

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- Include structured abstracts for original works and narrative abstracts for the other categories with a maximum of 250 words, in both languages, Portuguese and English, or Spanish when applicable, with the respective keywords.

- Verify if the references are listed according to the Vancouver style, numbered according to the order in which they appear for the first time in the text and if all of them are cited in the text.

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Signature of the author(s) Date ____ /____ /____

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