The causal model approach to nutritional problems: an effective tool for research and action at the local level

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Reported are the results of a case study from Kirotshe rural health district, Northern Kivu, Zaire, where a workshop on the causal model approach to nutrition was organized in 1987. The model has since been used in the field for research design, training of health professionals, nutrition intervention, and community development. The rationale behind this approach is reviewed, the experience accumulated from Kirotshe district is described, and the ways in which the causal model contributes to comprehensive health and nutrition care are discussed. The broad range of possible policy implications of this approach underlines its usefulness for future action.

Introduction

Severe nutritional problems in the Kivu highlands of Zaire have been reported and analysed since the 1950s (1–4). However, despite the implementation of coordinated health activities and the support given to community development, little progress has been made in controlling these problems, and the nutritional situation in the area still gives cause for concern (5).

On taking charge of the Kirotshe health district, Northern Kivu, in 1985, we observed that many health personnel were aware of the severity of the nutritional problems in the area, but did not know how to integrate nutrition into health programmes. Instead, they focused most of their efforts on growth monitoring at clinics for under-5-year-olds and expressed little concern about the selection of appropriate actions. Growth monitoring, however, is not likely to be worthwhile unless attention is paid also to the health and nutrition interventions needed (6).

Based on this and other observations, we discovered that many health staff working in the field required a comprehensive approach to health and nutrition care. Lack of knowledge about the causes of nutritional problems, the feasibility of nutrition interventions, and the means of effective communication within the community are a major constraint in many health and nutrition programmes (7, 8). In such programmes, a fundamental issue is how to design a tool that would be effective in generating and organizing knowledge that can lead to action.

This article advocates such a tool, which was initially developed for community nutritional assessment. The conceptual and methodological bases of this approach are reviewed, the experience accumulated in the Kirotshe health district is analysed, and the ways such an approach contributes to more comprehensive health and nutrition programmes are discussed.

The causal model approach

Conceptual background

The causal model approach assumes that complex problems require to be dealt with in a comprehensive, holistic manner. In the last two decades a number of global models of hunger and malnutrition have been proposed. In one of the earliest such attempts, Call & Levinson substantiated claims for a systematic approach to nutrition programmes (9). It is beyond the scope of the present article to review critically the various competing models, which although useful for analytical purposes, often are of limited use for planning or decision-making. The
review by Field illustrates the common failures of most attempts made to apply such models at the macrolevel (10). As discussed by Jonsson, the discrepancy between the level of analysis and the level of proposals for action is certainly a problem, and one which requires attention (7).

In the late 1970s Pradilla et al. provided an innovative alternative to modelling nutritional problems using a purely pragmatic approach (11). Starting from this proposal, Benthin et al. developed and improved the method, initially focusing on nutrition (12, 13)\(^a\), followed by its further application to other fields such as health services utilization\(^b\) or the control of infectious diseases (14, 15). This approach has been endorsed by WHO (16) and UNICEF.\(^d\)

A causal model is a hierarchically structured set of hypotheses on the causes or mechanisms that lead to the problem under study. Such a model attempts to provide an easily understandable analytical framework showing the complex relationships between all determinant factors underlying the problem. In this context, causality is suspected when a logical link between a factor and the problem of interest is identified.

The method applies knowledge, insight, and the field experience of a multidisciplinary panel of local experts to the problem under study and attempts to model how particular individuals achieve consensus on their situation; this consensus, however, is subject to re-examination and reformulation. The model is specific only for a given population at a given moment, and for a specific purpose.

**Methodology**

The methodology used in the causal model approach is described in ref. 16. By applying this methodology, workshop participants, through a series of “brainstorming” sessions, can easily pinpoint the few well-defined rules that are necessary to build the model.

The easiest way to start the process is to list all the factors that are relevant to the dependent variable. It does not matter which factors — biological, sociological, political, economic, etc. — are included in the model, as long as the group agrees with the listing. In a further step, causal factors are linked together in either a logical sum or a logical product. Causal chains are mapped as a network of boxes that are broken down at successive levels. The technique of model building is retrospective; it relates the dependent variable to the proximate determinants, in a top-to-bottom approach, against the flow of causality. The mapping ignores horizontal links and feedback loops, but these are most often implicit. Repetitions of the same factor are permitted. Finally, the model is completed by ordering and combining causal chains into a causal framework.

**Results**

**Development of the model**

The Kirotshe workshop on the causal model approach to nutritional problems took place in September 1987. The development of the model was the task of a multidisciplinary group of two international consultants in nutrition and 24 local participants (2 doctors, 3 nurses, 2 health workers, 3 nutrition technicians, 2 rural development technicians, 2 agronomists, 2 veterinarians, 2 farmers, 3 teachers, and 3 local politicians). Over five consecutive days, this group met in the mornings for brainstorming sessions devoted to model building, and in the afternoons to collect useful additional information on topics addressed during the development process. A secretary drafted the minutes of each meeting and collected the successive developmental stages of the model.

The group started with a basic model that included the following causal factors: breast-feeding, food intake, feeding practices, and the health status of the child (Fig. 1). According to this simple model, all the determinants of the nutritional status of the young

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\(^b\) Perez, J.A. Breast-feeding and medicine: a reassessment of historical trends and Third World needs. Antwerp, Institute of Tropical Medicine, 1989 (Working Paper No. 25).


child can be divided into two categories—those that influence the intake of food by the child, and those that influence the child’s utilization of the food; in turn, factors that affect food intake can be divided into two categories, etc. From this, the group built a series of submodels to elaborate on and provide further details about each factor under scrutiny. Examples that illustrate the development of these submodels are discussed below.

The food intake submodel (Fig. 2) highlights the crucial importance of the mother’s time availability as a factor that determines the nutritional status of her child. In African rural communities, women are often overwhelmed by their routine household tasks, and children are fully dependent on their mothers for their feeding because of the pattern of social roles. The submodel for mother’s time availability (Fig. 3) emphasizes the potential benefits of time-saving interventions that can free mothers from routine tasks. The workshop participants therefore agreed with the conclusions of a previous workshop on women in poverty: for poor women in developing countries saving time is development, for time saved from humdrum tasks is time to invest in human capital (17).

Those participants who were involved in agriculture and stock farming helped the group to analyse the complexity of the food production submodel process, which is one of the principal factors that has a bearing on a child’s food intake. A food production submodel was developed (Fig. 4), and causal chains were identified for the following factors: soil, capital, techniques, and manpower. These factors were assembled in a logical sum (Who is doing what, how and where?). The nutritional status of the child appeared to be an indicator of the socioeconomic situation as a whole. The relationships between food availability, soil preservation, and demographic pressure were strikingly similar to those modelled by Wils et al. in their systemic analysis of the ecosystem of the Kivu Mountains (3).
The submodel for child health status (Fig. 5) calls for particular attention. Although the participants were familiar with the distinction between health problems (needs), care-oriented behaviour (demand), and availability of health services (supply), it became clear to them that needs, demand, and supply are never matched; implementation of health services is not automatically followed by increased attendance at health centres or by direct improvement of health status. The participants concluded that it was more accurate to make a distinction between "the possibility of using services" and "the decision to use services". Such a conclusion was drawn also by da Silveira et al., and Mosley & Chen support this view in advocating the inclusion of personal illness control in any analytical framework of health problems (18). This part of the exercise stressed the need, in assessing health status, to combine sociological and anthropological methods with commonly used epidemiological approaches (19, 20).

**Uses of the model**

Since September 1987 the causal model has been successfully used for research design, education of health professionals, nutrition intervention, and community development.

**Research design.** Applied research, mainly on risk assessment in young children and on the health impact evaluation of the health programme, occupies a substantial part of the health and development activities in the Kirotseh district. The research agenda is planned by the health district authorities, with the collaboration of several funding agencies.

In designing a 1-year follow-up study that focused on the morbidity risk associated with the nutritional status of young children, we found that the causal model was extremely helpful for improving data collection. For example, the submodel for mother's availability of time (Fig. 3) stressed the need for accurate identification of a child's effective caretaker during the recall period. By including in the follow-up form a set of appropriate questions, we were able to calculate the potential risk of ill health associated with defective child care. In focusing on the distinction between the possibility and willingness to use health services, the submodel for child health status (Fig. 5) emphasized the usefulness of careful investigation of attitudes towards health care and services. Although social scientists have underlined this key question for some time (21, 22), its crucial importance for daily work in Kirotshe only became apparent after the workshop on the causal model approach. Therefore, in the follow-up form, we made a clear-cut distinction between a subject's and an observer's point of view. For example, a mother may consider

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*See footnote c, p. 716.*

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**Fig. 4. Schematic representation of the submodel for food production.**

**Fig. 5. Schematic representation of the submodel for child health status.**
that her child does or does not need care, and an observer may or may not agree with her. Independently of these viewpoints, the mother may express her intention to attend the health centre or not, and may subsequently make a decision that is or is not consistent with her expressed intention. Reported and observed attitudes require to be assessed separately and should be tested for consistency.

The causal model also proved useful for analysing data on 1096 under-5-year-olds collected during a 1-year follow-up study of the health impact evaluation of a water supply programme in Kirotshe (23). The analysis was carried out in keeping with the child health status submodel (Fig. 5) and the need to identify the users and non-users of facilities. Those people who were able to attend public taps had to decide whether or not to use them. No significant association was observed between the incidence of diarrhoea and the use of a water supply facility when this was assessed using subjective information (e.g., Do you use the tap? or Where are you drawing water from?). Many individuals could have claimed fallaciously that they were public tap users because of the social value attributed to “good” answers. However, very significant associations were observed between the incidence of diarrhoea and the use of public taps when such use was determined through objective water-related variables (the quantity of water drawn per household per day or the distance from the household to the tap). Causal factors previously identified in the workshop (i.e., “the possibility of using” and the “decision to use”) therefore proved to be useful in a completely different context.

**Education of health professionals.** Many paramedical students undergo 3 months of practical training in Kirotshe and are requested to submit a working paper at the end of this period. In this context, the causal model proved to be an effective pedagogical tool. Students were told to focus less on the scholastic aspect of the exercise and concentrate instead on the causal submodel most appropriate to the problem they had chosen. Each student then collected observational data on a set of households, and tried to refine the construction of the submodel. They were not asked to make any innovative contributions, but rather to try to formulate and address relevant questions and to enrich their own understanding of health problems.

One of the students, for example, concentrated on breast-feeding practices and improved the existing submodel by noting that breast-feeding was affected by seasonal variations in the availability of food. This observation is in accordance with previous studies by Vis et al. in the Kivu area (24, 25) and with a causal model of breast-feeding proposed by Perez. Another student tried to assess the differences in the feeding practices of children of two ethnic groups in the district. The Banyarwanda ethnic group from the Mitumba mountains, who live mainly on stock farming, almost never ate meat, but had a balanced diet of cereals, vegetables and tubers; the Bahunde ethnic group, on the other hand, who practise agriculture along the Kivu lakeshore, purchased more meat but lived on a diet of cassava flour. These observations provided the link between the production and consumption of food: food habits. A third student, who focused on the relationships between health status and health services utilization discovered that the children who were more frequently ill were those who made least use of the health centres; these children also had the poorest social conditions. This highlighted the social stratification that exists even in an apparently homogeneous poor rural community and prompted the following question: How can we improve the accessibility and the acceptability of the health services for the poorest (26)?

Using the causal model as a framework for collecting and connecting observational data, the students therefore succeeded in rediscovering by themselves causal factors and causal chains that had previously been identified in a different setting. The students learned in an interesting and stimulating way how the formulation of a conceptual model was effective in organizing knowledge and initiating a fruitful education process.

**Nutrition intervention.** Many health professionals who operate at the local level are convinced that taking care of a malnourished child only requires the provision of extra food. Considering that this approach was inappropriate and inadequate in the context of the rural health district of Kirotshe, we tested an alternative strategy. Initially we concentrated on the feeding practices causal submodel, which identifies the following common characteristics of the usual children’s diet in the Lake Kivu highlands: insufficient number of meals (1 or 2 per day); dull cassava flour diet; and fairly low consumption of grains (maize, sorghum) or legumes (beans, groundnuts), which are the major source of proteins. We therefore planned a new strategy, based on a proposal made previously by Beghin & Van Lerberghe (27).

In January 1989, 23 malnourished children from the village of Kirotshe-Mushindi (1475 inhabitants, medical census of 1987) were identified. All were suffering from clinical malnutrition and exhibited growth retardation, oedema, hair loss or depigmentation, and skin changes. The following proposal was
made: in return for providing the mothers with daily medical supervision and nutritional counselling for 13 weeks, they were asked to attend, in groups, daily educational sessions at the local clinic. During the first week the children received, if necessary, antimalarial and antihelmintic drugs and iron and folic acid supplements. The nutritional counselling focused on convincing the mothers to feed their children at least three times a day with balanced meals containing tuber flour, grains, and legumes. In addition, regular home visits were made to their households. No extra food was given or purchased. As a result, the intervention was almost restricted to social support and "homing-in" (28), both of which are time-consuming but inexpensive. The mothers attended the sessions regularly and better feeding practices resulted. All 23 children gained weight and height, and their growth curves improved dramatically. Oedema disappeared after 2–4 weeks, and the children rapidly became more active and cheerful; all but one were clinically healthy after 10 weeks (R. Tonglet et al., unpublished data, 1989).

**Community development.** The workshop stimulated participants to generate initiatives for community development. For example, one participant started an interesting development process in his own village in collaboration with the local health and development committee. The district health authorities and the village population had together built a small maternity ward near the health centre, but a large field remained vacant near the building. Encouraged by the local rural development technician who previously had attended the Kirotshe workshop, the committee decided to grow soya beans, which were then made available on the local market. The first crop was plentiful and the committee brought it to the village's mill; however, because milling is expensive the villagers could not afford to buy the flour. The committee then decided to buy its own mill. A cooperative store was established, funds were raised from its members, the U.S. Peace Corps provided the mill, and the committee was finally able to grind its own grain. After a 2-year follow-up study, we observed that most of the village women enriched the usual weaning porridge with soya bean flour, and also made biscuits from maize, sorghum, and soya bean flour; the feeding patterns were slowly changing. Encouraged by these results, the committee is now trying to popularize improved chicken and rabbit production in the village.

**Discussion**

At a meeting on child mortality held in Antwerp, Belgium, in 1985, Palloni underlined that causative research is flooded by theories and mathematical models but is short on conceptual models (29). Furthermore, Beghin stated that to explain better a phenomenon and the mechanisms leading to it, the following are needed: a theory; a conceptual framework or a causal model — preferably derived from the theory but not verifiable in itself; and a statistical or epidemiological model consisting of a set of testable hypotheses (30). These objectives are rarely if ever achieved.

Moreover, the lack of an appropriate analytical approach often results in ineffective interventions. The factors and processes that affect or underlie the health of the community, such as those that determine nutritional status, are usually complex. Health professionals working in the field are not always taught how to analyse and solve complex issues. This deficiency in the training of health personnel, lack of knowledge about causes, poor ability to intervene, and limited ability to communicate within the community, are probably among the common reasons for the failures observed when the impact of health and nutrition care is evaluated.

To correct this situation, health personnel need a method that assists them to clarify complex situations and to bridge the gap between analysis and intervention. Based on our experience in Kirotshe, building a causal model may be one of the most cost-effective methods for assessing health problems, identifying objectives for action, and evaluating health interventions.

At the Kirotshe workshop, the participants reached consensus over a structured set of causal factors and causal chains, which were postulated to be the major determinants of the nutritional status of young children in the health district. The resulting causal model is not theoretical, but rather a practical, conventional representation of the complex situation in the study area. Unlike models that are intended to be used in many different situations, our model in its present form is suitable only for local application; also, it is not a general model for malnutrition nor does it provide an etiological explanation of the natural course of malnutrition. Instead, it is a comprehensive set of causal hypotheses that reduces the chance of omitting relevant determinants and potential confounders. Furthermore, it is not a substitute for epidemiological models, and makes no use of statistics, although it facilitates better-designed data collection and analysis; it makes explicit hypotheses likely not to be evident and facilitates communication between individuals from different disciplines. It could be asked, however, whether these causal hypotheses could not have been formulated as well as without the need to construct a formal model. Probably they could, but certainly not in the local context of Kirotshe.
The model leads to better understanding among health professionals of the causal factors and causal chains that affect nutritional status and provides them with a framework for determining the processes whereby this status is influenced by programmes and policies. Therefore, the model is of value for research purposes and for community development and is consistent with current methods used in development planning; for example, target-oriented programme planning (TOPP). TOPP, however, is more than an approach; rather, it is a general and detailed planning method that considers causes and ranks objectives. The causal model adopted in Kirotshe is more empirical, opening up a wide range of unexpected initiatives, and stimulating investments in health and development.

The place of the causal model approach in the process of generating knowledge is still a matter of debate. However, its scientific and operational merits are evident for professionals in the field. The model bases its legitimacy on the classic paradigm of experimental science: first construct a hypothesis, then derive from it a model that is a simplified representation of the reality, and finally test the goodness-of-fit of the model and its validity. In addition, we believe that it also satisfies the following basic criteria of action-research, as defined by Susman & Evered (31): it is future-oriented and has close affinities with the planning process; it is collaborative; it implies system development; it generates theory grounded in action; it is subject to re-examination and reformulation; and it is situational, i.e., can change with the setting. With these criteria action-research can also be viewed as a cyclical process of identifying a problem, selecting courses of action, evaluating interventions, and specifying learning from action to reassess the original problem. As a result of the Kirotshe workshop, various individuals in the district were involved in such a cyclical process. With a fairly low investment — mainly human resources — we established, surprisingly successfully, the utility and feasibility of a complex process of organizing knowledge, generating new hypotheses, and identifying appropriate interventions.

In addition, the Kirotshe experience seems to be the first example of the sustained use of the causal model approach over a period of years in the same setting.

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**Résumé**

L'approche causale en nutrition: un outil utile pour la recherche et l'action au niveau local

Dans les pays en développement où les problèmes nutritionnels sont extrêmement préoccupants, les professionnels de la santé éprouvent très souvent des difficultés à organiser des soins de santé et de nutrition intégrés; l'expérience a montré qu'ils méconnaissent les causes des problèmes nutritionnels, sous-estiment les possibilités effectives d'intervention et négligent les moyens d'améliorer la communication au sein de la communauté pour promouvoir de bonnes conditions alimentaires et nutritionnelles. Dans ce contexte, il est nécessaire de pouvoir mettre à leur disposition un outil qui les aide à recueillir et organiser les connaissances indispensables à l'action. L'approche causale, proposée par l'OMS en 1988, nous semble adaptée à cet objectif.

L'approche causale est fondée sur la conviction qu'il est nécessaire de gérer les problèmes complexes d'une manière globale et qu'une bonne compréhension des causes et des mécanismes de ces problèmes est un préalable indispensable à toute décision. La construction d'un modèle causal hypothétique, applicable à une situation donnée, est au cœur de cette méthode. Le terme “modèle” est employé ici au sens d'une représentation simplifiée d’un système ou d’un processus. Le modèle est appelé “causal” car il présente un jeu d’hypothèses logiques mettant en relation de manière hiérarchique les différents facteurs déterminants du problème étudié. La méthode fait appel aux connaissances, aux intuitions et à l'expérience d’une équipe pluridisciplinaire d’experts locaux, qui s’efforcent de clarifier leur perception collective du problème étudié, dans un contexte particulier et à un moment donné. La construction d’un modèle causal passe par a) l’identification de tous les facteurs biologiques, sociologiques, politiques, économiques ou autres, qui permettent de formuler des hypothèses causales quant à la genèse du problème étudié, b) le repérage des liens logiques qui unissent ces fac-

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9 [Target-orientated programme planning]. Eschborn, German Agency for Technical Cooperation, 1987 (in German).
teurs entre eux et à la variable dépendante, et c) l'organisation et la combinaison de ces chaînes causales au sein d'un schéma conceptuel matérialisé par un graphique simplifié. Le modèle défini au terme de cet exercice n'a rien de définitif. Les hypothèses causales seront vérifiées ou non; de nouvelles hypothèses pourront être formulées et enrichir le cadre analytique initial; les résultats de l'analyse causale devront être adaptés en fonction des modifications du contexte de départ.

En septembre 1987, la zone de santé rurale de Kirotshe (Nord-Kivu, Zaïre) a organisé un atelier afin de procéder à l'analyse causale des problèmes nutritionnels du jeune enfant dans la région. Ce séminaire, qui a réuni 26 experts locaux pendant une semaine, a permis d'identifier les sources d'information disponibles, d'élaborer une représentation simple et facile à communiquer de la réalité complexe des problèmes nutritionnels de la région, et de sélectionner les facteurs qui se prêtent à une intervention.

Au terme de cette analyse, la zone de santé de Kirotshe disposait d'un outil de travail qui, depuis lors et de manière continue, est apparu extrêmement utile pour a) améliorer la collecte et le traitement des données dans le cadre de la recherche appliquée, b) contribuer à la formation du personnel de santé, c) planifier des interventions nutritionnelles pertinentes au niveau local et d) encourager de nouvelles initiatives en faveur du développement communautaire. L'expérience acquise à Kirotshe montre que la méthode proposée crée des conditions susceptibles de dynamiser un programme de santé et de nutrition et de mobiliser ses différents partenaires.

Il serait utile de soumettre l'analyse causale à la critique épistémologique, mais il suffit ici de constater que cette méthode est manifestement fondée sur le paradigme classique de la science expérimentale: d'abord formuler une hypothèse, ensuite bâtir un modèle et donc proposer une représentation simplifiée de la réalité, enfin chercher à vérifier la validité du modèle et son adéquation à la réalité. Il n'est donc guère étonnant de voir des professionnels de santé constater, de manière tout à fait empirique, la valeur scientifique et opérationnelle de l'approche causale, sur le terrain. Un modèle causal, en effet, n'est pas un échafaudage théorique ayant une valeur universelle, mais la représentation conventionnelle et pratique d'une réalité locale. L'analyse causale ne se substitue pas aux modèles épidémiologiques et ne fait pas usage de techniques statistiques, mais elle permet d'identifier de manière exhaustive les facteurs déterminants du problème étudié et de clarifier des hypothèses qui souvent sont impliquées mais dissimulées aux yeux des opérateurs, sur le terrain. L'approche causale, en outre, initie un processus cyclique qui débute avec l'identification d'un problème, se poursuit avec l'analyse de celui-ci et s'oriente ensuite vers la planification et l'évaluation d'interventions pertinentes. L'expérience de Kirotshe confirme le bien-fondé des hypothèses conceptuelles et méthodologiques à la base de cette méthode et illustre à quel point l'approche causale est un outil utile pour la recherche-action au niveau local.

References


