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A concept mapping study of nutritional knowledge in diabetic children and their parents : detailled version

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Abstract :

The objectives of this research are to describe the organization of knowledge and its evolution following education sessions in 5 diabetic children and their mothers, and to evaluate the similarities and differences between children and their mothers. 10 concept maps were realized for children and their mothers on the subject of “food”, and analyzed in terms of the organization and nature of the knowledge. Before the education session, mothers and children are highly knowledgeable about food. The logical organization of knowledge in children (which depends on their developmental stage) differs from that found in mothers (which is based on problems to be resolved). Everyone speaks about food in a similar manner. After the sessions, new links between old and recent knowledge testify of learning. A comparison between the maps of children and their mother reveals similarities but also differences in their preoccupations. This research shows how these knowledge networks evolve over a period of education. It emphasizes the difficulties patients meet when trying to integrate new knowledge. Using the preexisting knowledge networks as a guide, educators should be able to achieve specific intervention in a patient’s knowledge and more efficiently account for similarities and differences in children and parents preoccupations.

Key Words : Children, Diabetes, Concept mapping, Knowledge, patient education

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1. Introduction

The therapeutic education of a diabetic child and his parents is directed towards the acquisition of self-care and psycho-social skills, so that they can better manage the disease [1]. One of the most important skills to master is that of managing a diet that is both balanced and suitable to their life situation.

Among the elements of this skill, knowledges and their mode of organization play a decisive role [2,3]. Dietary knowledge is particularly difficult to learn and teach, however, as it is influenced by the representations and beliefs arising from each individual's familial and social history [4]. This kind of knowledge is also influenced by evolving scientific texts. Several conditions must be fulfilled for a dietary skill to be implemented. One condition is that all family members (parents and children) must share a number of knowledges, thus making it easier to choose a diet that is suitable for the patient's treatment. The important role of parents in their children's dietary education has been demonstrated in several studies on obesity [4-6]. Throughout their dietary education, especially prior to adolescence, children will imitate their parents and notably their mother. In addition, children need to know that their parents share the same dietary knowledges and behaviors that have been recommended to them by medical staff [7].

In a previous study we have shown that it is possible to use the concept mapping technique in interviewing children of age 8 and up, in addition to the questionnaires more commonly used to evaluate the knowledge of diabetic children [8]. This study also stressed the importance of information gathered about the nature and organization of children's knowledges. Cognitive psychology theories emphasize that knowledge organization is a decisive factor in the successful application of a skill. According to these theories, the manner in which a person creates links between their knowledge elements is predictive of their competence level [9-11]. It is therefore of prime importance to study the knowledge networks of diabetic children and their parents.

2. Method

2.1 Research Objectives

The first objective is to study the nature of individual knowledges, their organization with respect to a given theme (food), and their evolution over a period of 4 months. This study does not directly evaluate the education received in these sessions, however, since informal education events may also take place during this period.

The second objective is to study the similarities and differences between the concept maps of children and their parents, and to discuss these differences in the context of designing a better pedagogical approach.

2.2 Research Environment

The “Aide aux Jeunes Diabétiques (AJD)” is an association that provides children and their parents with informational and educational resources to help them manage diabetes[12-13]. Two years ago the association opened a Therapeutic Educational Center, located in Paris, which is open to all young diabetics in the Ile-de-France region. In this center therapeutic education programs are provided to groups of children of various ages (from 5-year olds to adolescents), as well to their parents.

For children between 8 and 9 years old, the program consists of six monthly 3-hour sessions running from September to March (Table 1). One of which was specifically dedicated to questions of diet. The session objectives are based on ISPAD recommendations [14]. Parents participate in identical sessions at the same time as their children. Each session is concluded by a round-table discussion between children, parents, and educators, which encourages parents to recognize the value of their child’s training and facilitates consensus on how the lesson objectives will be applied at home.

2.3 Construction of the maps

To better evaluate the knowledges of each, interviews with a child and their parent were conducted simultaneously by two different researchers. These interviews were held once right before the second session of the education program, entitled “What are we eating?”, and again about 4 months later. A concept map was generated over the course of each interview, which lasted 15 minutes for the children and 30 minutes for the parents. The technique of concept mapping consists of exploring a person’s knowledge starting from a central concept (here, “food”) which is placed in the middle of the page [15]. Any knowledge and ideas expressed by the interviewee that are related to the central concept are progressively recorded in the diagram [8, 16]. The result obtained is a graphical representation (Figure 1) of the ensemble of meaningful propositions. The interviews were recorded so that the authenticity of the concept maps could be verified.

2.4 Analysis of the concept maps

We analyzed the content of each map by dividing it into meaningful propositions, or “cognitive units” (generally two concepts or nodes linked by an explicit arrow) [17]. To evaluate the nature and organization of the cognitive units, we adapted the analysis grid used in one of our previous studies [18].

2.4.1. Organization of the knowledges

In terms of the organization of knowledges, we studied 1) the presence or absence of a given knowledge domain or related notions, and 2) the links that may exist between these various knowledge domains.

The knowledge of diabetic patients on the subject of food can be divided into 9 principal domains: 1) food groups ; 2) nutritional content or nutrients ; 3) dietary organization ; 4) hypoglycemia; 5) hyperglycemia; 6) glycemia ; 7) treatment (insulin); 8) complications; and 9) physical activity (sports).

2.4.2. Nature of the knowledges

The propositions expressed in the concept maps were analyzed in three aspects:

1. Their declarative, conditional, or experiential nature. A proposition or a series of propositions is considered declarative when it describes facts, rules, or principles; conditional when it describes the implementation of an action under specific conditions; and experiential when it describes knowledge drawn from personal (usually subjective) experiences. Also included in the latter category are propositions expressed by children based on the actions of their parents in a specific situation, and vice versa.

2. The type of interconceptual link used in a proposition. All links were placed into one of 5 categories [8, 18]: a) links expressing generalities such as definitions, rules, and physiopathological principles; b) links expressing examples; c) links of cause and effect; d) ways of behave links; and e) affective links, including emotions, opinions (of the parents on their child, on the educational sessions, or on the knowledge obtained).

3. The quality of the propositions in terms of their scientific validity. In this validity analysis, propositions of a subjective nature (affects, opinions, or experiences) are not taken into account. Several categories have been identified: a) propositions that are true with respect to scientific data; b) propositions that are false with respect to scientific data; c) incomplete but partially true propositions, which often are not formulated with sufficient precision to be considered completely true but reflect valid knowledge nonetheless; d) uncertain propositions reflecting a doubt or absence of knowledge as claimed by the patient himself, which are therefore useless [19-20]. The ensemble of links in the 10 maps was analyzed by two experts in diabetes following this categorization.

To identify the concept maps before and after education, we denote the first map “CC1” and the second “CC2”. To denote maps belonging to a child and their mother, we add the child’s first initial (CC1S) along with the letter “M” in the case of a mother (CC1MS).

3. Results

Ten concept maps were created with 5 children, spread across the 4 educational groups that were opened to children aged 8-9 in 2004, and ten more maps with their respective parents (mothers only). Children and mothers were volunteers to participate in study. The children (3 boys and 2 girls) all had lived with type 1 diabetes for over one year, had a treatment of 2 insulin injections per day, and an HbA1c between 7.4 and 10.2 (the normal range is 4.2-5.6). These children generally had between 4 and 5 diabetology consultations per year.

3.1 Knowledge organization

Before the education, all children and their mothers approach the notion of food from the perspective of dietary balance. Children first describe food groups, then the organization of meals; mothers first describe dietary organization over the course of a day (regularity of meals, snacks and refreshments), then food groups and nutrients (Table 2). The concept of food allows them to express their dietary knowledge and relate it to other notions important to diabetes: between 4 and 8 knowledge domains or notions are present in each concept map derived from the children and their mothers (Table 2).

Among the children's maps we find 4 to 5 of the 6 food groups, and among the mothers' 4 to 6. Oils are absent from all of the children's maps and are only present in 2 of the mothers' maps (CC1MN, CC1MM). Fruits and vegetables are mentioned in practically all maps. Fruit is mentioned alone, or sometimes appears as part of a "dessert" group along with other foods such as dairy products and cookies. The "meat, egg, fish" group is often complete among the mothers, but rarely complete among the children (CC1N); the "meat" concept is the only one found in all the maps. The associations "starchy food – slow sugars" and "sweets – quick sugars" are present in all but one of the child maps, and in three of the mother maps.

The children talk about nutritional content very little. The notion of "vitamins" is present in all children, while proteins are found in 2 maps (CC1L, CC1S), carbohydrates in only one map (CC1C),

and fats and fibers in none of the maps. This knowledge domain is relatively developed, however, among the mothers.

After the education, the organization of knowledge in the subjects does not change much. A new domain appears in the maps of only 3 children. Although the number of links between knowledge domains seems to decrease between the first and second map, all the children and 3 out of 5 mothers express new links between domains in CC2 (Table 2). Certain notions or domains appear in CC2 and generate new links, while others disappear in CC2 along with their connecting links. Only 2 children (CC2M, CC2S) and 3 mothers (CC2ML, CC2MN, CC2MS) touch on the oil group after education, and the notion of "starch sugar" appears on one child map (CC2N).

3.2. The nature of the knowledges

The nature of the propositions and the type of links expressed by both children and mothers do not vary much between the 2 research phases, (Figures 2 and 3). The propositions are mainly declarative for both CC1 and CC2. We notice that the percentage of propositions reflecting the children's experience tends to increase over the period of research, from 4 propositions (2%) to 13 (6%). Additionally, children almost never express emotions or opinions (only S expressed an emotoin, in CC2), as opposed to mothers for whom this type of link is very important (14.2% in CC1 and 24.5% in CC2).

Most of the propositions are considered true or partially true (incomplete) by the experts at both stages of the research (Figure 4). Table 3 presents the content of those propositions which were defined as incomplete by the experts. Eight incomplete knowledges identified in the CC1 maps of all the children and two of the mothers are found again in CC2, while 3 of the incomplete knowledges identified among the children in CC1 seem to become more specific in CC2. The false knowledges expressed in CC2 are different from those expressed in CC1, except for one. In CC2, one mother corrects a false knowledge that she expressed in CC1. An uncertain knowledge expressed by one child and his own mother in CC1 is found again in CC2 for both subjects. Three of the uncertain

knowledges expressed by children in CC1 were completed in CC2. Finally, note that analysis of the CC2 maps cannot determine whether or not certain of the "incomplete, erroneous or uncertain" knowledges identified in CC1 were modified, as some of these concepts were not expressed again in CC2.

3.3. A comparison of each child's concept map with that of their mother

The overall content of the false propositions varies between children and their mothers. Mistakes in the classification or content of food products are made by children, while mistakes in the role of food on glycemia are made by mothers. Errors in the proper organization and content of meals are found in the maps of both children and mothers (Table 3). Neither similarities nor correspondences appear in the false knowledges expressed by a child and their own mother. In two cases certain incomplete knowledges, such those concerning the concepts of slow and quick sugars, are identical in the maps of a child and their mother (L and N). One mother is curious about the content of dairy products at both stages of the research, and her child shows the same curiosity in CC2 (N). Generally, the most important similarities concern the presence or absence of knowledge domains and notions, the linking process (e.g., the high level of lunch-time hyperglycemia in CC2 for both C and MC, due to their diet), a common learning process (e.g., the notion of fiber was acquired by both L and ML in CC2), and shared personal experiences (e.g., the effect of potatoes on glycemia described by both S and MS). Other propositions, however, demonstrate a difference in preoccupations essentially related to the notions of hypoglycemia and hyperglycemia. While some children seem more preoccupied by hypoglycemia (as is the case for C, M and L who often mention hypoglycemia in their maps), their mothers talk more about hyperglycemia. On the other hand, one child (S) seems preoccupied only with hyperglycemia while his mother (MS) worries about hypoglycemia. Finally, the notion of forbidden foods is present in the maps of two children but absent from those of their mothers.

4. Discussion

4.1. Discussion of the method

Recall that this is a qualitative, descriptive study carried out on a limited sample (5 children and 5 mothers). Its purpose is therefore not to generalize the observations carried out, but only to better understand through an in-depth analysis the ways in which children and their parents integrate dietary knowledge in a given context. We developed a second concept map following the education process. But it cannot be said with certainty that the observed transformations constitute learning linked to the educational sessions. The absence of a knowledge in the concept maps doesn't necessarily signify a lack of knowledge in the subjects. Finally, the knowledges have been validated by experts in diabetes who are also directly involved in the therapeutic education program. Their judgment may therefore have been influenced by the educational messages delivered during the sessions.

4. 2. Discussion of the results

The concept maps obtained prior to the educational session reveal the richness and complexity of knowledge organization in children and their mothers.

Children generally approach the concept of dietary balance from the perspective of food groups, while the mothers describe the composition of various meals. Among the children, we can therefore speak of a *conceptual* organization with a certain degree of hierarchy [15]. Among the mothers, on the other hand, the organization of knowledge seems more closely related to the *manner* of its everyday use. This indicates another kind of organization, according to types of problem solving. In fact, the organization of knowledge evolves little over the period chosen for this study. Even though the central concept triggers a spontaneous activation of knowledge in the subject, this organizational stability may be expected given that the everyday problem of food always brings up the same difficulties and calls on the same knowledge domains. All children express new relationships between knowledge domains after education. This would seem to indicate that real learning

occurred. In effect, as stated by Ausubel, learning does not only result from the accumulation of knowledge but also from the creation of new links between preexisting knowledges [9, 21]. Finally, although the methodology employed in this study doesn't always permit us to follow the evolution of an expressed knowledge, the retention of some uncertain or erroneous knowledges can still be observed by comparing the form of the maps before and after the education sessions.

It seems that some learning can be deduced from the analysis of transformations observed in the concept maps after education. Some notions which are initially absent from the concept maps of children appear later (e.g., oils and fiber), which could be linked to the education sessions. The mothers also seem to enrich their knowledge concerning nutrients. On the other hand, other "expected" learning (considering the displayed program of the education session) seems to be insufficiently represented. For example, the concept of glucides (sweet and starchy carbohydrates) is almost entirely absent from the maps of children after education, even though it is one of the messages of the program. This can be partly explained by the fact that there is often a difference between the program as announced and the program as implemented, some adaptations being necessary for each group of children. Given this, the children (and the mothers, for that matter) continue to use the concepts of "slow sugars" and "quick sugars" to classify certain foods as starchy food or sweets respectively, as well as to describe the composition of meals and the effects of certain foods on blood glucose level. Propositions utilizing these concepts have been judged incomplete by the experts. While these notions have long been used to explain to diabetic patients how they should feed themselves, along with the concept of forbidden foods, the scientific community has decided that they should no longer be used [22-23]. Our study therefore shows the degree to which these anterior knowledges persist. Several hypotheses can explain this difficulty. The first reflects the level of adherence among health personnel to scientific recommendations, and the time and means required to assimilate new knowledge [24]. In effect, the cases of children (and mothers) who have participated in education sessions are followed by many different health professionals whose discourse on diet and nutrition varies from place to place. The second hypothesis concerns the

educator's difficulties to base their approach on the trainee's current knowledge network, which must be explored beforehand, as several studies have already demonstrated [18-25].

The concept mapping technique can be used to discover how the patient speaks spontaneously on a subject while respecting their mode of expression and vocabulary. As in preceding studies [8, 18], in both children and their mothers we principally find declarative knowledges: generalizations or examples, with some supporting arguments and ways of behave. The children's expression of conditional knowledge bears witness to their capacity to progressively elaborate their thoughts, as expected given their stage of development [26]. The mothers, on the other hand, verbalize numerous propositions based on their personal experience. Among these propositions, many have a positive (e.g. "cold cuts are so good!") or negative (e.g. "nutrition is frustration!") emotional connotation, again demonstrating the extent to which cognitive structure, knowledge, and emotions are linked [27]. These propositions underline the burden that each child's illness represents for their mother, and the degree to which the act of feeding oneself is emotionally charged. The latter cannot be reduced to its nutritional dimension [28]. This type of proposition was not found in the children's concept maps, however, except for one. This relative absence of emotion is probably related to the developmental stage of the children, who are just beginning to take notice of their feelings. A child's capacity for emotional expression seems more spontaneous after 10-11 years [26]. For younger children explicit interrogation seems necessary to elicit emotions. Some authors have resorted to other means, such as writing and performing skits to help children express their emotions [13, 29]. In their experiential propositions, some children verbalize personal experiences that sometimes reveal erroneous knowledge (e.g. "Potatoes don't raise my blood sugar"). The importance of the child's perception in the development of causal thought has already been emphasized [30]. The role of experience in the acquisition of knowledge is as important as the reinforcement of certain knowledges by adults (as is the case for the mother in the preceding example, who said "If he eats potatoes without bread, he gets hypoglycemic").

Finally, a comparison of the concept maps of children with those obtained from their mothers reveals certain features which seem important to discuss. Analysis of the maps demonstrates that parents and children share certain knowledges (for example, dietary balance, food groups, and the role of fibers and nutrients), which can only be explained by their reinforcement through daily management of the illness. This comparison often reveals differences of preoccupation as well, however, for example concerning hypoglycemia and hyperglycemia. These differences in preoccupation suggest possible consequences on treatment management by the child and his mother.

Diabetes educators could analyze their educational sessions on the subject of nutrition in terms of the different organizational modes identified in this study (conceptual organization in children, and problem-solving organization in the mothers). Taking these differences into account will help the subjects link new concepts to their anterior knowledge network. The concept map can be an advantageous technique, provided that caregivers are trained in their use and can produce a rapid and simplified analysis of the maps. A round-table discussion between parents and children concerning similarities and differences could be implemented. It would help parents and children anticipate the frustrations and obstacles that they could encounter [31].

Finally, if in a given context the proposition of a central concept for the map sometimes activates a knowledge or affect in a person, some authors see this as evidence of a “background” of links with other types of proposition (desire, intention, belief, etc.) which are also important to understand. In effect, these propositions could reveal in the most valid possible manner the intimate logic to which patients resort in their reasoning and decision-making [32].

In conclusion, this study, using concept maps as a research tool, demonstrates once more the complexity and richness of knowledge organization and the nature of patient knowledge in children and adults. It confirms the preexistence of knowledge networks, which must be taken into account in therapeutic education. It testifies to the significant learning that takes place by creating links between new knowledge and the anterior knowledge network. Finally, these thought-provoking results raise

questions which are probably necessary to the betterment of therapeutic education, principally that concerning parent-child training.

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