Nutrition Guidance by Primary-Care Physicians: LISREL Analysis Improves Understanding

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Background. When determinants of nutrition guidance practices for primary care physicians (PCPs) are identified, the key question remains: what is the mechanism of action? This knowledge is essential in order to understand how PCPs practice nutrition guidance.

Methods. Mail questionnaires (result of focus-group discussions and in-depth interviews) were sent to a nation-wide random sample of 1,000 PCPs in the Netherlands, who had been in practice for between 5 and 15 years (633 respondents). The mechanism of action of determinants of nutrition guidance practices of PCPs was identified by means of linear structural relationship analysis (LISREL) using a postulated model.

Results. The postulated model on the mechanism of action was confirmed. The model demonstrates that nutrition guidance practices of PCPs are directly and significantly based on a few predisposing factors; driving forces and perceived barriers may act as significant intermediary variables. The predisposing factors, driving forces, and perceived barriers were identified.

Conclusion. Policies to improve nutrition guidance practices of PCPs in the Netherlands are determined on the one hand by a number of perceived barriers such as lack of nutrition training and education and lack of time [14,15], and on the other hand by several driving forces, such as an active interest in the effect of nutrition on health and disease [15]. We have now performed an in-depth analysis of the mechanism of action of determinants of nutrition guidance practices of PCPs using linear structural relationship analysis (LISREL). A better understanding of this mechanism could be extremely beneficial when planning interventions to improve the nutrition guidance practices of PCPs [16]. Until now, LISREL methodology has not been used in determining nutrition guidance practices of PCPs. In this article, we present LISREL models on factors influencing nutrition guidance practices of PCPs in the Netherlands. In addition, we compare the LISREL models with the results of the more traditional multiple regression analysis (MRA) [15] to evaluate their differential instrumentality in leading to a clear understanding of the mechanism of action of determinants of nutrition guidance practices of PCPs.

METHODS

Sample

A random sample of 1,000 primary care physicians was drawn from the 2,798 PCPs in the Netherlands.
who had been practicing for between 5 and 15 years. In October 1992, the 1,000 PCPs received a specially developed mail questionnaire (the Wageningen PCPs Nutritional Practices Questionnaire), based on the methodology of Dillman [17] as described previously [14]. The Wageningen questionnaire was based on qualitative research (focus-group discussions and in-depth interviews) and consisted of issues such as personal characteristics, description of the practice, task perception as primary care physician, sources of information on nutrition, nutrition guidance practices, and the barriers to be coped with (e.g., lack of time). Special attention was given to two typical examples of nutritional problems: treatment and prevention of overweight and coronary heart disease. The items suggested as possible barriers were taken from the literature and from previous qualitative research. Attitudinal and behavioral questions were scored on a 5-point Likert scale [14], unless stated otherwise.

Characteristics of the 633 PCPs who responded to the questionnaire have been reported in a previous publication [14], and are briefly summarized in Table 1. The net response rate was 64%. The 633 respondents were well representative of the population of PCPs who had been in practice for between 5 and 15 years according to gender, year of starting practice, and gender by type of practice distribution [14]. Seventy percent of PCPs in our study claimed to be interested in the effect of nutrition on health (and 25% said that they were “neutral” in this respect) [14].

**Hypothesis**

Our hypothesis is shown in Fig. 1. In this general model the nutrition guidance practices of PCPs (dependent variable) are determined by a mechanism in which the predisposing factors, with or without the intermediary factors (driving forces and barriers), play a major role. The arguments for this hypothesis are based upon the predisposing, enabling, and reinforcing factors of Green and Kreuter in their Precede-Propose Model [16], and upon our previous qualitative research. The report on the qualitative research is only available in the Dutch language: De huisarts en voedingsvoorzichting, december 1991. Translated title: The primary care physician and patient nutrition guidance, December 1991.) In addition, we hypothesize that barriers will have a negative effect on driving forces.

In this article we will first discuss as a dependent variable in the general model the variable “extent of nutrition education and information” of PCPs [15], followed by the PCPs’ involvement in “noticing overweight in patients and the giving of guidance of treatment” [15]. These variables were chosen as the two most important behavioral variables, from the nutrition guidance variables studies thus far [15].

**Dependent Variable “Extent of Nutrition Education and Information”**

The variable “extent of nutrition education and information which PCPs give to their patients” was scored in one question on a 5-point Likert-type scale, ranging from “not at all” to “very intense.”

The analysis of focus-group discussions and in-depth interviews with PCPs revealed the following four predisposing factors for this dependent variable:

- perception of own ability to influence the lifestyle and eating habits of patients with health problems (which is a self-efficacy factor) [16,18–20];
- interest in the effect of nutrition on health and disease;
- perception of own ability to give dietary advice on the treatment and prevention of coronary heart disease (which is also a self-efficacy factor [16,18–20]); and
- perception of role of behavior and heredity in health.

We analyzed whether these predisposing factors act directly on the dependent variable and/or whether driving forces or barriers act as intermediary variables.

**Dependent Variable “Noticing Patients’ Overweight and Guidance of Treatment”**

The variable “noticing patients’ overweight and guidance of treatment” was operationalized in six items, on the basis of factor analysis [15] (Cronbach’s α = 0.66). One item addresses the percentage of patients of whom the PCP notices their weight. Five items are about guidance of treatment: three concern the discussion of overweight problems and two concerning the extent of the advice. The analysis of focus-group discussions and in-depth interviews identified the same four predisposing factors for this dependent variable as for the dependent variable “extent of nutrition education and information” discussed above. We also analyzed whether these predisposing factors act directly on the dependent variable and/or whether driving forces or barriers act as intermediary variables.

**TABLE 1**

<table>
<thead>
<tr>
<th>Characteristics of 633 Respondents and Their Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Age (mean ± SD)</td>
</tr>
<tr>
<td>Mean time in practice</td>
</tr>
<tr>
<td>Mean practice list</td>
</tr>
<tr>
<td>Mean number of patients a day</td>
</tr>
<tr>
<td>Planned time per consultation</td>
</tr>
<tr>
<td>Situation of practice</td>
</tr>
<tr>
<td>Type of practice</td>
</tr>
</tbody>
</table>
Statistics

The principal components analysis with varimax rotation (factor analysis) was used for scale construction [21]. Skewed distributions were normalized by square root transformation. Cronbach's α was used as a measurement of reliability of scales derived from factor analysis. Factors were defined as sums of items, standardized for scale width. Differences between the predisposing factors in their effect on the dependent variable were tested with the Student's t test.

Influencing factors on the dependent variable using MRA were reported before [15]. A major drawback of MRA is that only direct influences can be studied, while independent variables may have a direct (i.e., corrected for covariables) and an indirect (i.e., via covariables or intermediary variables) influence. The LISREL analysis [22] offers a good opportunity to distinguish direct and indirect influences (as may be specified from theoretical considerations) by which the mechanism of action of the determinants is identified. In this respect MRA may be seen as a generalization of LISREL.

To identify the mechanism of action of determinants of the dependent variables, LISREL path analysis was used (Program Version 7.16 [22]). When the conditions of (a) low residuals, (b) all t values of effects >2, and (c) an acceptable Q plot of all standardized residuals are fulfilled [22], the LISREL solution was accepted. \( \chi^2_{df} \), P, and adjusted goodness of fit index (AGFI) are presented to indicate the quality of the model.

RESULTS

Dependent Variable “Extent of Nutrition Education and Information”

The 16 factors used in the LISREL path analysis for analyzing the dependent variable “extent of nutrition education and information” by PCPs (Cronbach's α = 0.66) are given in Table 2. Of these 16 factors, 9 have a high Cronbach's α and 2 have a moderate Cronbach's α. The other 5 factors were based on one question.

The hypothesis that the dependent variable is determined by predisposing factors, with or without intermediary factors, could be confirmed because the LISREL program provided a model with an excellent fit [22] (Fig. 2). The obtained model fits the empirical data \( (\chi^2_{df} = 31.13, P = 0.185) \); the AGFI = 0.977. The percentage of explained variance in “the extent of nutrition education and information” by the LISREL model is 33% (which is good agreement with the 32% obtained by multiple regression analysis [15]).

From the LISREL model of Fig. 2 it also becomes clear that the following three predisposing factors: perception of own ability to influence the lifestyle and eating habits of patients with health problems...
TABLE 2
Nutritional Attitudes and Beliefs and Perceived Barriers to Nutrition Guidance Practices (the Majority Resulting from Factor Analysis), Used in the LISREL Path Analysis of "Extent of Nutrition Education and Information" (A) and of "Noticing Patients' Overweight and Guidance About Treatment" (B)

<table>
<thead>
<tr>
<th>Description</th>
<th>α*</th>
<th>Itemb</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in the effect of nutrition on health.</td>
<td></td>
<td>1</td>
<td>A, B</td>
</tr>
<tr>
<td>Perception of own ability to influence lifestyles and eating habits of patients with health problems (self-efficacy factor).</td>
<td>0.78</td>
<td>2</td>
<td>A, B</td>
</tr>
<tr>
<td>Perception of own ability to give dietary advice in the treatment and prevention of coronary heart disease (self-efficacy factor).</td>
<td>0.70</td>
<td>2</td>
<td>A, B</td>
</tr>
<tr>
<td>Perception of role of behavior and heredity in health.</td>
<td>0.73</td>
<td>7</td>
<td>A, B</td>
</tr>
<tr>
<td>Task perception.</td>
<td>0.69</td>
<td>24</td>
<td>A, B</td>
</tr>
<tr>
<td>Attitude regarding treatment of overweight.</td>
<td>0.65</td>
<td>5</td>
<td>A, B</td>
</tr>
<tr>
<td>Attitude toward weight–health relationship.</td>
<td></td>
<td>1</td>
<td>A, B</td>
</tr>
<tr>
<td>Attitude toward the role of diet in CVD.</td>
<td></td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Lack of nutrition training and education (perceived barrier).</td>
<td>0.76</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>Lack of skills to treat overweight (perceived barrier).</td>
<td>0.65</td>
<td>5</td>
<td>A, B</td>
</tr>
<tr>
<td>Lack of time to treat overweight (perceived barrier).</td>
<td>0.74</td>
<td>2</td>
<td>A, B</td>
</tr>
<tr>
<td>Lack of patient motivation to reduce overweight (perceived barrier).</td>
<td>0.67</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Appreciation of Standard Cholesterol Protocol and its applicability.</td>
<td>0.74</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>Body mass index of the PCP.</td>
<td></td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Workload (function of number of patients in practice and number of patients seen per day).</td>
<td>0.72</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>Opinion about effectivity of obtaining adequate nutrition education by congresses or educational courses.</td>
<td>0.78</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>Nutrition interest of partner of PCP.</td>
<td></td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>Type of practice.</td>
<td></td>
<td>1</td>
<td>B</td>
</tr>
</tbody>
</table>

a Cronbach's α, a measure of reliability of the factors.
b Number of items constituting a factor.

Table 2 presents the results of a factor analysis that identified several key factors influencing the extent of nutrition education and information, as well as the noticing of patients' overweight and guidance about treatment. These factors include interest in the effect of nutrition on health, perception of own ability to influence lifestyles, self-efficacy factors related to giving dietary advice and treatment of coronary heart disease, role perception in health, and various barriers such as lack of nutrition training and education, time constraints, etc.

TABLE 3
Effects of the Predisposing Factors on the Dependent Variables "Extent of Nutrition Education and Information" (See Model Fig. 2) and "Noticing Patients' Overweight and Guidance of Treatment" (See Model Fig. 3)

<table>
<thead>
<tr>
<th>Effect on variable &quot;extent of nutrition education and information,&quot;a</th>
<th>Self-efficacy general</th>
<th>Nutritional interest</th>
<th>Self-efficacy CHD</th>
<th>Role of behavior in health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect</td>
<td>0.051 ± 0.012</td>
<td>0.094 ± 0.017</td>
<td>0.130 ± 0.020</td>
<td>0.039 ± 0.010</td>
</tr>
<tr>
<td>Direct effect</td>
<td>0.100 ± 0.032</td>
<td>0.147 ± 0.032</td>
<td>0.141 ± 0.030</td>
<td>—</td>
</tr>
<tr>
<td>Total effect</td>
<td>0.151 ± 0.034</td>
<td>0.241 ± 0.036</td>
<td>0.271 ± 0.036</td>
<td>0.039 ± 0.010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effect on variable &quot;noticing patients' overweight and guidance of treatment,&quot;a</th>
<th>Self-efficacy general</th>
<th>Nutritional interest</th>
<th>Self-efficacy CHD</th>
<th>Role of behavior in health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect</td>
<td>0.103 ± 0.017</td>
<td>0.015 ± 0.018</td>
<td>0.072 ± 0.014</td>
<td>0.080 ± 0.016</td>
</tr>
<tr>
<td>Direct effect</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.133 ± 0.035</td>
</tr>
<tr>
<td>Total effect</td>
<td>0.103 ± 0.017</td>
<td>0.115 ± 0.018</td>
<td>0.072 ± 0.014</td>
<td>0.213 ± 0.038</td>
</tr>
</tbody>
</table>

a Values ± SE.
effect of a perceived barrier (lack of time to treat overweight) on a driving force (attitude regarding the treatment of overweight). This effect confirms the hypothesis in our model, Fig. 1.

Personal habits affecting the health of PCPs are sometimes considered barriers to health promotion behavior [4,7,8,23-25]. We used the body mass index (BMI) of the PCP (as an indication of personal habits affecting health) in our LISREL path analysis (see Table 2) to test whether it was a predisposing factor or an intermediary factor in the model of Fig. 2. It proved to be neither (possibly because of its distribution: 75% of the PCPs had a normal BMI (20 ≤ BMI ≤ 25) and only 1% had a BMI > 30).

Dependent Variable “Noticing Patients’ Overweight and Guidance of Treatment”

The 11 factors used in the LISREL path analysis for analyzing the dependent variable “noticing patients’ overweight and guidance of treatment” are given in Table 2. Of these 11 factors, 5 have a high Cronbach’s α and 3 have a moderate Cronbach’s α. The other 3 factors were based on one question. The hypothesis that the dependent variable is determined by predisposing factors, with or without intermediary factors, could be confirmed because the LISREL program also provided a model with an excellent fit [22] (Fig. 3). The obtained LISREL model of Fig. 3 fits the empirical data (χ² df = 22 = 20.74, P = 0.537); the AGFI = 0.984. The percentage of explained variance in “noticing patients’ overweight and guidance of treatment” by the LISREL model is 23% (which is in agreement with the 25% provided by multiple regression analysis [15]).

From this LISREL model (Fig. 3) it becomes clear that all predisposing factors act, in principle, through intermediary factors on the dependent variable. Only the predisposing factor “role of behavior in health” acts directly on this dependent variable, the direct effect being the most important one.

The effects of the above-mentioned predisposing factors on the dependent variable are given in Table 3. We observe that the predisposing factor “role of behavior in health” scores the highest effect followed by, respectively, the predisposing factors “self-efficacy general,” “nutritional interest,” and “self-efficacy CHD.” There is a strong tendency of positive indirect effects via driving forces on the dependent variable.

Integration of Results

Our hypothesis and model (Fig. 1) were confirmed by the models (Figs. 2 and 3) based upon our research data. The findings clearly indicate that PCPs’ involve-
ment in nutrition during general practice, e.g., the extent of nutrition education he/she is giving, or alertness in identifying and treating overweight (which are the dependent variables) is the result of both a number of predisposing factors and a number of so-called intermediary factors which act either as driving forces or as perceived barriers.

DISCUSSION AND CONCLUSIONS

This study confirms that PCPs' nutrition guidance practices are determined partly directly by predisposing factors and partly indirectly via driving forces and barriers which play an intermediary role. The postulated hypothesis and model (Fig. 1) developed on the basis of qualitative research and measured attitudes could be confirmed.

In both constructed LISREL models (Figs. 2 and 3) four predisposing factors were identified as playing a major role:

- perception of own ability to influence the lifestyle and eating habits of patients with health problems;
- interest in the effect of nutrition on health and disease;
- perception of own ability to give dietary advice on the treatment and prevention of coronary heart disease; and
- perception of role of behavior and heredity in health.

In both LISREL models the driving forces “task perception” and “attitude regarding treatment of overweight” and the perceived barriers “lack of skills to treat overweight” and “lack of time to treat overweight” play a definite role as intermediary variables. In one LISREL model (Fig. 2) “attitude toward the role of diet in CVD” is added as a driving force and “lack of nutrition training and education” as a perceived barrier. In the other LISREL model (Fig. 3) the driving force “attitude toward weight–health relationship” is entered.

One important difference between the LISREL models (Figs. 2 and 3) is the way the perceived barriers act on the dependent variables. In the LISREL model on determinants of “extent of nutrition education and information,” the perceived barriers “lack of time” and “lack of nutrition training and education” have a direct effect on the dependent variable. Such a direct effect of perceived barriers, however, is not found in the LISREL model on “noticing patients' overweight and guidance of treatment.”

Although PCPs perceive “lack of patient motivation to reduce overweight” as a barrier to treatment of overweight [14], in reality this perceived barrier does not
play a role in the mechanism of action of determinants of the dependent variable “noticing patients’ overweight and guidance of treatment” (Fig. 3). This result is in agreement with the findings of multiple regression analysis [15]. The danger of this perceived barrier is that it can become a self-fulfilling prophecy: trying to reduce overweight in patients thought by PCPs to lack motivation will—in their perception—not lead to success, so PCPs might ask themselves: what is the rationale of trying?

Another surprising finding is that the two perceived barriers “lack of skills” and “lack of time to treat overweight and guidance of treatment” (Fig. 3). This result noticing patients’ overweight and guidance of treatment.”

In this study we have used the LISREL analysis methodology. This methodology has not been previously used in determining nutrition practices of primary care physicians. However, there are recent articles on dentists’ practices [26] and on occupational stress among family physicians [27], using this methodology. What advantages does the LISREL method have compared with the more traditional MRA? For our study we can state that LISREL provided us with a more in-depth understanding of the mechanism which influences the dependent variables “extent of nutrition education and information of PCPs” and “noticing patients’ overweight and guidance of treatment.”

A comparison of our LISREL model (Fig. 2) with findings using MRA [15] leads, for the dependent variable “extent of nutrition education and information of PCPs,” to the following conclusions.

There is good agreement on the percentage of explained variance between the two methods: 23% LISREL (Fig. 3) and 25% MRA [15]. Of the four predisposing factors in the model, only the most important one will be identified as a determinant by MRA [15]. The three intermediary factors “task perception,” “attitude regarding treatment of overweight,” and “attitude toward weight–health relationship” in our model will be delivered as determinants by MRA [15]. However, the two perceived barriers in the model were not delivered as determinants by MRA [15], probably because they exert their effect via attitude regarding the treatment of overweight. The variable “type of practice” which is a determinant in MRA [15] does not have a place in the LISREL model in Fig. 3.

In this case, the advantages of the LISREL model compared with MRA are very clear. The LISREL model leads to a clear understanding of the structure among determinants, whereas MRA will not deliver three of the four predisposing factors, nor the two perceived barriers. Green and Kreuter’s central message [16] is first to try to understand the factors that influence behavior (educational and organizational diagnosis) before coming to the administrative and policy diagnosis and later on to implementation. We have shown that the additional use of LISREL is of paramount importance for this understanding.

In general, policies to improve nutrition guidance practices of PCPs might in future benefit from a LISREL model analysis of determinants of these practices in order to become more effective. If MRA is used to ascertain the determinants of these practices, this could result in missing important predisposing factors and hidden intermediary factors, and therefore in an incomplete understanding of the mechanism of action.

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REFERENCES