

# Validation of a Screening Tool to Identify the Nutritionally at-Risk Pregnancy

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## Abstract

**Objective:** To assess the efficacy of a screening tool to be used by nurses to determine which economically disadvantaged pregnant women are most likely to benefit from a dietitian's intensive intervention.

**Methods:** The 26-variable screening tool was used by 53 nurses in 17 Montreal primary care facilities at first contact with 300 subjects who were eligible for prenatal programs for low-income women. Among these, 259 subjects were subsequently interviewed by a Montreal Diet Dispensary (MDD) dietitian using the Higgins Method, established as the gold standard for the detection of a nutritionally at-risk pregnancy. Comparisons of the results obtained by dietitians using the Higgins Method with scores obtained by nurses using the screening tool to determine risk levels and individual variables were analyzed using the Pearson correlation coefficient, receiver operating characteristic (ROC) curves, and predictive indices such as sensitivity, specificity, and predictive values.

**Results:** Because of low agreement between the findings of MDD dietitians and nurses using the screening tool, 10 variables were excluded. The resulting 16-variable tool showed a correlation coefficient of 0.70. The ROC cut-off for this simplified tool was 8, meaning that a woman would be considered at nutritional risk if her score was 8 or more. This score optimized sensitivity (85%) with rather low specificity (50%), but retained a positive predictive value of 87% and a negative predictive value of 55%.

**Conclusion:** Revisions of the screening tool to identify nutritionally at-risk pregnant women led to the development of a simplified screening tool with an acceptable measure of nutritional risk in pregnancy. Hence, the use of this tool by any health professional will identify the majority of the nutritionally at-risk pregnant women most likely to benefit from a dietitian's intensive intervention.

**Key Words:** Nutrition, pregnancy, risk factors, screening, prenatal

Competing Interests: None declared.

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## Résumé

**Objectif :** Évaluer l'efficacité d'un outil de dépistage devant être utilisé par des infirmières pour identifier les femmes enceintes défavorisées sur le plan économique les plus susceptibles de tirer avantage d'une intervention intensive de la part d'un diététiste.

**Méthodes :** L'outil de dépistage à 26 variables a été administré (dans le cadre de la première consultation) à 300 sujets admissibles aux programmes prénatals destinés aux femmes à faible revenu par 53 infirmières, au sein de 17 établissements de soins primaires montréalais. Deux cent cinquante-neuf de ces sujets ont par la suite fait l'objet d'une entrevue menée par un diététiste du Dispensaire diététique de Montréal (DDM) au moyen de la méthode Higgins, laquelle est reconnue à titre d'étalon-or pour la détection d'une grossesse à risque sur le plan nutritionnel. Les comparaisons entre les résultats obtenus par les diététistes au moyen de cette méthode et les scores obtenus par les infirmières au moyen de l'outil de dépistage, en vue de déterminer les degrés de risque et les variables individuelles, ont été analysées au moyen du coefficient de corrélation de Pearson, de courbes de fonction d'efficacité de l'observateur (FEO) et d'indices d'efficacité de la prédiction (tels que la sensibilité, la spécificité et les coefficients de prévision).

**Résultats :** En raison de la faible concordance entre les résultats obtenus par les diététistes du DDM et les résultats obtenus par les infirmières au moyen de l'outil de dépistage, 10 variables ont été exclues. L'outil à 16 variables résultant a indiqué un coefficient de corrélation de 0,70. Le seuil FEO de cet outil simplifié était de 8, ce qui signifie qu'une femme serait considérée comme courant des risques sur le plan nutritionnel si elle obtenait un score de 8 ou plus. Ce score optimisait la sensibilité (85 %) et s'accompagnait d'une spécificité plutôt faible (50 %), mais conservait un coefficient de prévision d'un test positif de 87 % et un coefficient de prévision d'un test négatif de 55 %.

**Conclusion :** Les révisions apportées à l'outil de dépistage visant à identifier les femmes enceintes qui courent des risques sur le plan nutritionnel ont mené à l'élaboration d'un outil de dépistage simplifié permettant une mesure acceptable du risque nutritionnel au cours de la grossesse. Ainsi, l'utilisation de cet outil par n'importe quel professionnel de la santé permettra d'identifier, dans la plupart des cas, les femmes enceintes courant des risques sur le plan nutritionnel qui sont les plus susceptibles de tirer avantage d'une intervention intensive de la part d'un diététiste.

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## INTRODUCTION

Over the last 20 years, the incidence of low birth weight in Canada has been stable at approximately 6%, but in some developed countries it is approximately 4%.<sup>1</sup> Maternal malnutrition is a widely recognized contributing factor to LBW.<sup>2,3</sup> LBW babies have higher rates of morbidity than those born at an appropriate weight,<sup>4</sup> and they pose a greater financial burden on the health care system.<sup>5</sup> There are reasons to believe that some of the factors involved, namely maternal nutrition, may be modifiable.<sup>6</sup>

The rates of LBW and other adverse birth outcomes are higher in economically disadvantaged populations.<sup>1,2,7-10</sup> This supports the need for heightened clinical vigilance and counselling for low-income pregnant women<sup>10</sup> who are known to be at greater risk of malnutrition.<sup>2,6,11</sup> As a number of factors, such as cigarette smoking, drug use, isolation, and emotional stress, are either directly or indirectly related to malnutrition,<sup>6,11</sup> nutritional assessment must be adequately addressed in the course of comprehensive prenatal programs such as the Canada Prenatal Nutrition Program.

After the implementation of the CPNP in 1994, the increasing number of projects (more than 300 in 1997) began to strain resources. There were very few dietitians involved in conducting dietary assessment and providing counselling to participants, and the popularity of the projects led to more demands than could be met. This situation led to the necessity of determining which of the women requesting services were at greatest risk of malnutrition, so that services could be tailored to their needs.

Since the 1950s, the Montreal Diet Dispensary has been providing nutritional advice to economically disadvantaged pregnant women, using the Higgins Method. This is a system of nutrition counselling provided by a dietitian that includes information about corrective allowances (in calories and protein), according to identified risks, coupled with food and vitamin supplements. Evaluation studies have

shown that LBW rates were reduced by at least 50%<sup>12</sup> and preterm birth rates by at least 30%<sup>13,14</sup> following the MDD's intervention. Furthermore, the applicability of the Higgins Method in settings other than the MDD has been documented, and a cost-benefit analysis showed a saving of at least \$8 for each dollar invested in the program.<sup>15</sup>

By the end of the 1980s, the high demand for its unique service prompted the MDD to develop a process for identifying the women most at risk of having a LBW baby, in order to give them priority access to the dietitian's nutrition counselling. A scoring system for a number of socio-demographic and behavioural variables and elements of the patients' medical and obstetrical history was put in place, tested, and implemented. When a pregnant woman first calls to request the nutritional service, the MDD receptionist asks questions related to these variables. Clients are identified as being at low, moderate, or high risk, and initiation of service by a dietitian is determined on this basis.

In 1996, an extension of MDD services was begun on a contract basis in a Centre local de services communautaires. As the number of low-income mothers far exceeded the time allotted to MDD services in this setting, the need for a screening device became obvious. In contrast to the MDD, CLSC was not able to provide a dietitian's counselling for all women seeking service. For this purpose, the MDD developed an experimental version of its own screening process that included dietary variables designed to evaluate the mother's protein intake, which is known to be a reliable predictor of diet quality.<sup>16,17</sup> Women at high risk would be referred to a dietitian for nutritional care plan and follow-up. Women at moderate risk would undergo assessment by a dietitian who would establish a nutritional care plan and follow-up or assign follow-up to a nurse. Women at low risk would receive basic nutritional information and follow-up from a nurse.

A 1998 literature review<sup>18</sup> found only one screening tool targeting the nutritionally at-risk pregnancy.<sup>19</sup> Because that tool has not been validated, and because it was intended for a non-Canadian population, the MDD conducted a validation study of its experimental screening tool.

The main objective of this study was to evaluate the effectiveness of the MDD's newly devised screening tool to be used by nurses to determine which economically disadvantaged pregnant women are most likely to benefit from a dietitian's intensive intervention.

## MATERIALS AND METHODS

The screening tool submitted to validation was pre-tested by CLSC nurses, who reported no significant difficulty in completing it. The tool questioned the mother-to-be on 26 risk factors/variables. Nineteen of these were non-dietary:

### ABBREVIATIONS

CI	confidence interval
CLSC	Centre local de services communautaires
CPNP	Canada Prenatal Nutrition Program
GRIP	Groupe de recherche sur l'inadaptation psychosociale de l'enfant
LBW	low birth weight
MDD	Montreal Diet Dispensary
NPV	negative predictive value
PPV	positive predictive value
ROC	receiver operating characteristic

age, income, type of work, parity, closely spaced pregnancy, previous LBW baby, previous abortions, illnesses, pre-pregnancy weight, weight change, pregnancy complications, smoking, drinking, drug use, single or multiple pregnancy, gestational age, absent father, serious emotional problem, and support. The remaining seven were about diet: interval between meals and consumption of food in six groups, from which protein intake can be estimated: (1) milk and yoghurt; (2) potatoes, bread, cereal products; (3) meat, poultry, fish, and liver; (4) eggs; (5) cheese; (6) legumes, nuts, and peanut butter. Each variable had a weighted score based on scientific evidence<sup>20,21</sup> and on MDD experience. For CLSC nurses, the use of the tool involved recording a score for each variable, totalling score results, and recording additional information on date, location, and duration of the subject's interview.

The protocol of the study was submitted and approved by the Comité d'éthique de la recherche of the Centre de recherche Fernand-Seguin, affiliated with the Université de Montréal.

The screening tool was used by primary care nurses at first contact with economically disadvantaged pregnant women. Sixteen CLSCs and one community clinic participated in the study.

Instructions on the use of the study material could not be delivered in the same way at all sites. In some instances, meetings were held with only the nurses' coordinator, while in others, five to ten nurses were present. At initial contact with a pregnant woman, before conducting the usual intervention, the nurse explained the nature and conditions of the study, a signed consent was obtained, a short questionnaire was administered, and agreement to a subsequent interview by a MDD dietitian was sought. The completed screening tool was mailed to the Groupe de recherche sur l'inadaptation psychosociale de l'enfant for data entry and analysis, and the MDD was informed that a subject was available for interviewing.

As soon as possible, a MDD dietitian met the subject and conducted an interview, using the Higgins Method.<sup>22,23</sup> Upon completion of the interview, the MDD dietitian reported her designation of the subject's risk level.

The standard to which the screening tool results were compared was the clinical judgement of MDD dietitians applying the Higgins Method, previously established by inter-rater reliability tests. The validity criterion was determined by comparing the risk levels obtained by primary care nurses using the tool with those obtained by MDD dietitians conducting an initial interview with the client.

To establish the level of agreement between scores on individual variables obtained by use of the tool and the gold

standard Higgins Method, transcripts of subjects' MDD interviews were put on a screening tool form consisting of the 26 variables and the dietitian's evaluation of the pregnant woman's protein and caloric intake. To reduce the possibility of false interpretation or recording errors, these transcripts were subsequently reviewed by the principal investigator and the dietitian who conducted the interview, the latter having the final decision on any matter needing clarification.

The representativeness of the study population was verified by comparing sociodemographic variables and risk factors between subjects and MDD clients.

Data entry and analyses were carried out in collaboration with the GRIP at the Université de Montréal, thus providing the project with expertise in epidemiology and statistics.

Analyses were conducted using SPSS, version 10 in Windows (SPSS Inc., Chicago IL). Means and standard deviations were reported where applicable. A chi-square test or Student *t* test was used to test the differences between study subjects and MDD clients where appropriate. Kappa test and Pearson correlations were used to verify the agreement between the two groups of assessors. The reliability of risk scoring was verified by the intra-class correlation coefficient.

It was projected that a minimum of 246 subjects would be required, because with this sample size a two-sided 95% CI for a proportion using the large sample normal approximation would extend 0.05 from the observed proportion for an expected proportion of agreement of 0.8. An additional 20% was established to account for inadequate completion of the tool, refusals and withdrawals, rounding the total sample size to 300.

To ensure maximal benefit to all those who needed nutritional intervention, the level of risk was dichotomized as low (subjects not necessarily needing the dietitian's intensive intervention) or moderate-high (subjects needing nutritional intervention). This resulted in a two-level screening process in which the decision to involve a dietitian is taken after a thorough evaluation of the mother's nutritional status. Sensitivity was defined as the percentage of women identified as being at moderate-high risk through use of the screening tool (CLSC nurses) among those identified as such by MDD dietitians. Specificity was defined as the percentage of women identified as being at low risk, using the screening tool among those identified as such by MDD dietitians.

The positive predictive value, the proportion of true moderate-high risk subjects among those identified as such by screening, is used as a guide in decision-making about the implementation of screening programs. The negative

**Table 1. Population characteristics:\* study subjects compared with MDD clients**

Characteristic	Study (n = 262)	MDD (n = 1308)	Characteristic	Study (n = 262)	MDD (n = 1308)
Age†			Source of income‡		
≤ 19 years old	18.3	7.8	Welfare	50.8	41.9
≥ 20 years old	81.7	92.2	Wages, inadequate	17.9	31.0
Schooling			None	11.1	7.6
0 to 9 years	23.7	23.2	Wages, adequate	10.3	5.1
10 or 11 years	25.9	27.0	Government assistance‡	7.6	12.3
> 12 years	50.4	49.8	Other	2.3	2.1
Country of origin‡			Gravida		
Canada	47.3	21.9	First pregnancy	35.5	30.3
Others	52.7	78.1	Second pregnancy	22.5	25.9
Living in Canada			Third pregnancy	19.8	20.4
< 1 year	14.0	16.7	Fourth pregnancy or more	22.2	23.4
1 to 2 years	22.1	16.6	Corrections§		
≥ 3 years	63.9	66.7	None	21.8	19.2
Race†			One	41.2	39.1
Caucasian	67.9	52.8	≥ Two	37.0	41.7
Others	32.1	47.2	Risk factors		
Language†			Smoking, alcohol, drugs†	32.1	15.6
English	24.8	28.2	Prior poor pregnancy outcome¶/†	41.6	30.8
French	72.5	62.5	Under nourishment¶/#	40.8	48.7
Other	2.7	9.3	Failure to gain weight¶	21.0	24.7
Marital status			Underweight¶/**	19.1	11.0
Married/common law	59.2	63.1	Serious emotional stress¶	11.8	9.0
Single	33.6	29.1	Closely spaced pregnancy¶	8.4	10.0
Widow, divorced, separated	7.3	7.9	Pernicious vomiting¶	1.5	3.1
Family size			* Data expressed in percentages		
One	14.1	10.4	† P < 0.001		
Two	36.3	35.3	‡ Other than welfare		
Three	23.7	27.3	§ In calories and protein, according to risks considered in the Higgins Method		
≥ 4	24.9	27.0	Non-cumulative percentages		
Family type			¶ Risks for which a calorie-protein correction is applied in the Higgins Method		
Monoparental	35.1	33.4	# P = 0.016		
Biparental	64.9	66.6	** P = 0.002		

predictive value is the proportion of true low-risk subjects among those identified as such by screening.

The ROC curve, commonly used to evaluate the performance of screening tools, was also used. The result of this test allows for determination of a cut-off point that optimizes both sensitivity and specificity.

## RESULTS

### Descriptive Results

Fifty-three nurses completed assessments, using the screening tool in 300 pregnant women between July 1999 and July 2000. Two assessments were rejected because they were inadequately completed. Of the 298 subjects whose

assessments were completed, 262 were interviewed by one of the nine MDD dietitians; the other 36 either refused the MDD interview or could not be reached by the MDD. Data from three of the 262 subjects interviewed by MDD dietitians failed to reach the GRIP. Consequently, comparative analyses were performed on 259 nurse-completed assessments matched to the data compiled from the subjects' interviews conducted by MDD dietitians.

Table 1 shows the characteristics of the 262 subjects gathered from the MDD dietitians' intake forms compared with those of the 1308 MDD clients during the year of the study. The two groups differed in some sociodemographic characteristics. Study subjects were significantly younger, more likely to have been born in Canada, and more likely to be

Caucasian and French-speaking than the MDD clients ( $P < 0.001$  for all variables). However, no difference was observed with respect to level of education, immigration, marital status, family size, and family type. Although the distribution of income sources appeared to vary greatly ( $P < 0.001$ ), after grouping the categories known not to meet a minimum adequate standard of living<sup>24</sup> (inadequate wages, public assistance, and no income), 79.8% of study subjects and 80.5% of MDD clients were identified as at risk because of insufficient income. Study subjects and MDD clients were similar in lifestyle and health/nutrition characteristics, and both required a similar number of nutritional corrections (in calories and protein) according to the Higgins Method, although the distribution of the risk factors encountered was different. Twice as many study subjects as MDD clients were users of cigarettes, alcohol, or drugs ( $P < 0.001$ ), more of them were underweight ( $P < 0.002$ ), and they tended to have a poorer previous obstetrical history ( $P < 0.001$ ). On the other hand, more MDD clients were undernourished, i.e., had a low calorie/protein intake ( $P = 0.016$ ).

Interviews took an average of  $18.1 \pm 10.7$  minutes. As expected, the majority (196/259) of the nurses' interviews were conducted at the subjects' homes, because most of the participating CLSCs offer home visits as part of their prenatal program for low-income pregnant women. The same nine MDD staff dietitians involved in the establishment of the gold standard assessment were involved throughout the duration of the study data collection. Their interviews with the subjects were conducted either at the MDD (125) or at the subjects' homes (134).

The interviews conducted by the nurse and by the MDD dietitian were separated by a mean  $9.8 \pm 8.6$  days. No significant difference was noted when the overall results were compared to those with a delay of  $\leq 7$  days or a delay of  $\geq 14$  days between the two interviews.

### Initial Scores

On the basis of MDD experience, the following cut-off scores were established: low risk  $\leq 12$ ; moderate risk  $> 12$  to  $18$ ; high risk  $> 18$ .

Average total scores obtained by CLSC nurses showed an overestimation of risk levels compared with the estimations of MDD dietitians ( $21.92 \pm 8.1$  vs.  $18.76 \pm 7.84$ ), although the average total scores of both groups were in the high-risk range. The difference between average total scores of 3.16 was statistically significant (paired Student *t* test  $P < 0.001$ ). The Pearson correlation between these total scores was 0.63.

Overall results showing risk levels for the 259 matched subjects and for the 36 mothers who were not interviewed by

MDD dietitians are shown in Table 2. In data obtained by CLSC nurses, these 36 unmatched subjects appeared to be at slightly lower risk than the women whose data could be matched with that of the MDD dietitians (respectively 22.2% vs. 9.3% at low risk, and 52.8% vs. 64.5% at high risk). When comparing the results obtained by CLSC nurses for the 259 subjects with those obtained by MDD dietitians, the use of the tool by nurses tends to overestimate risk level.

In comparing the dichotomized risk levels (low risk vs. moderate-high risk) in Table 3, the level of agreement between MDD dietitians and CLSC nurses was low (Kappa statistic 0.247; 95% CI 0.059–0.434). A sensitivity of 94.5% and a specificity of 25% were observed, and the PPV and NPV were respectively 83% and 46%.

### Simplification of the Tool

Because little agreement was obtained between CLSC nurses (using the tool) and MDD dietitians (Higgins Method), ten variables were excluded from the screening tool. These were type of work (Kappa: 0.30), pregnancy complications (Kappa: 0.12), support network (Kappa: 0.24), interval between meals (Kappa: 0.13), and the six food-consumption variables because they failed to estimate protein intake (Kappa: 0.22).

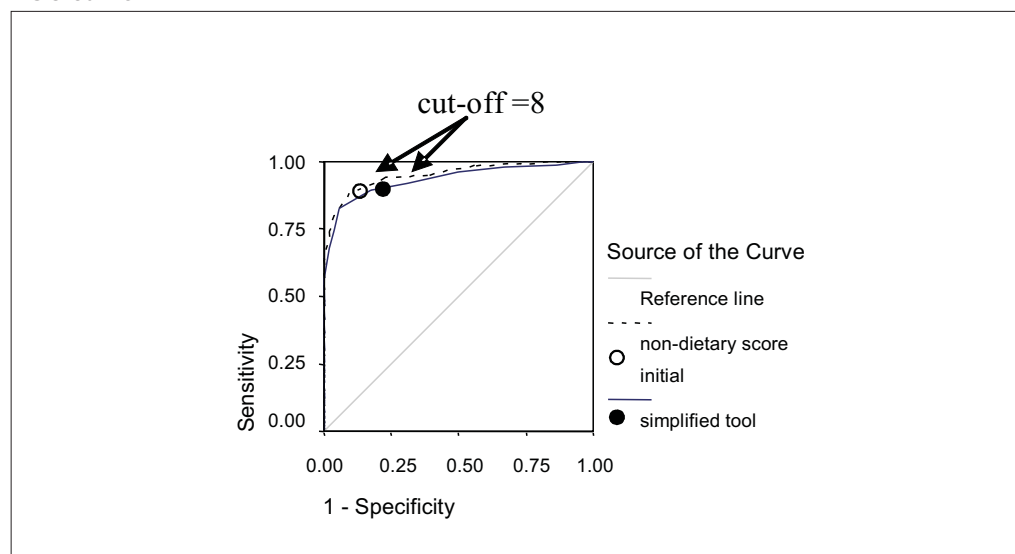
The resulting simplified tool comprised 16 non-dietary variables (age, income, parity, closely spaced pregnancy, previous LBW baby, previous abortions, illnesses now including pregnancy complications, pre-pregnancy weight, weight change, smoking, drinking, drug use, single or multiple pregnancy, gestational age, absent father, and serious emotional problem now including social isolation). The total scores of this final simplified tool averaged  $12.01 \pm 6.31$  and  $12.64 \pm 6.55$  among MDD dietitians and CLSC nurses respectively (difference 0.63,  $P = 0.041$ ). Although the nurses' scores remained higher than those of the dietitians, the difference between scores was smaller than when the original tool was used (3.16), and the level of agreement was improved (Pearson's correlation 0.70, Kappa statistic 0.331; 95% CI 0.179–0.482). Thus, the tendency to overestimate risk level was greatly reduced by using the simplified tool.

A cut-off for this simplified tool was established with the ROC curve (Figure), using the dietitians' initial score (moderate-high risk vs. low risk). The optimal cut-off chosen was 8 or more, i.e., a woman will be considered at risk (moderate or high) with a score of 8 or more in the 16 non-dietary variables retained. The dichotomized risk levels obtained by the nurses using the tool with this cut-off are shown in Table 4. This score optimizes sensitivity (85%) and specificity (50%) using the simplified tool, resulting also in a PPV of 87% and an NPV of 55%.

**Table 2. Risk levels according to the low, moderate and high risk levels among the 259 matched subjects seen by both nurses and dietitians and 36 seen only by nurses**

Risk level	Dietitians		Nurses			
			Matched subjects		Unmatched subjects	
	n	%	n	%	n	%
Low	52	20.1	24	9.3	8	22.2
Moderate	100	38.6	68	26.3	9	25.0
High	107	41.3	167	64.5	19	52.8
Total	259	100.0	259	100.0	36	100.0

**ROC curve**



**Reliability**

The intra-class correlation coefficient between the MDD dietitians and CLSC nurses was enhanced by the refinement of the assessment tool, increasing from 0.58 (95% CI 0.42–0.70) for the 26-variable initial tool to 0.70 (95% CI 0.63–0.76) for the final 16-variable tool. These coefficients verify that in using the non-dietary variables, CLSC nurses obtained results that were similar to those of MDD dietitians.

**DISCUSSION**

The purpose of this validation study was to verify in an iterative fashion whether the MDD screening tool could identify pregnant women most likely to benefit from a dietitian’s intensive intervention. The recommended simplified tool shows a high degree of reliability, very satisfactory sensitivity and specificity, and a good positive predictive value.

The study was conducted with subjects eligible to participate in the CLSC prenatal programs for low-income women. Low income is recognized as a major risk factor for

poor pregnancy outcome,<sup>1,2,6–10</sup> and inadequate nutrition is known to be prevalent in such populations.<sup>25</sup> These women face many factors that impede the success of their pregnancy and the health of their baby. Among these, nutrition is modifiable. In pregnancy, the woman is more motivated to modify nutritional habits in order to set a course towards healthier eating and living for her future family.

Ideally, all low-income women should see a dietitian during pregnancy. However, in the context of scarce resources, it is recommended that cut-off points be set with less than perfect sensitivity in order to maximize the benefits of service.<sup>2</sup> As cut-off points become more restrictive, women who could benefit from nutrition intervention will not be served, leading to higher costs associated with LBW and prematurity.<sup>15</sup> Those who are screened and seen by the dietitian, despite being at lower risk, would then be referred back to the nurse for follow-up appointments. The costs associated with these low-risk cases would not be great, because the service would involve only one visit with a dietitian. A dietitian’s services are non-invasive and low in cost.

**Table 3. Agreement of dichotomized risk levels (moderate-high vs. low) between MDD dietitians and CLSC nurses using the 26-variable initial screening tool**

Risk level according to CLSC nurses	Risk level according to MDD dietitians		
	Moderate-high	Low	Total
Moderate-high	196	39	235
Low	11	13	24
Total	207	52	259

**Table 4. Agreement of dichotomized risk levels (moderate-high vs. low) between MDD dietitians and CLSC nurses using the 16-variable simplified tool**

Risk level according to CLSC nurses	Risk level according to MDD dietitians		
	Moderate-high	Low	Total
Moderate-high	175	26	201
Low	32	26	58
Total	207	52	259

Application of the Higgins Method has been shown to result in long-term savings in a cost-benefit analysis study.<sup>15</sup>

The clinical importance of the screening tool in the context of CLSCs is that such a tool determines who will most benefit, thus initiating service earlier for pregnancies at higher risk. This is important, because pregnant women are frequently referred for nutritional counselling too late in pregnancy.<sup>26</sup> To maximize the benefits of service and the potential for longer term behaviour change, it is important for the dietitian to intervene early in the pregnancy and to maintain follow-up throughout pregnancy.<sup>12,27–29</sup>

An insufficient proportion of low-risk subjects (< 10%) could have jeopardized the validity of the results. The 20.1% rate of low-risk subjects (Table 2) identified by the Higgins Method overrides this possible bias. Interestingly, the level of MDD clients who, in application of the Higgins Method, do not require nutrition corrective allowances, i.e., who are at low nutritional risk, is also consistently ≈ 20%, as confirmed in Table 1, as well as in MDD studies.<sup>12,22</sup>

Some causes for variation between the two assessment sources were addressed after further application of the tool, thus enhancing its efficacy. These causes were as follows:

1. Training on how to complete the tool was minimal in the majority of participating CLSC sites.
2. A pre-test was not conducted in each site before data collection.

3. The high ratio of nurses (53) to subjects (300) gave very few users the chance to become quite familiar with the tool (10 nurses used it only once), and variability between surveyors in a set of similar subjects was not assessed.
4. Part of the data collection period coincided with a Quebec nurses' strike. In some cases, this may have disrupted the users' motivation and attention in completing the tool.
5. The delay between the nurses' and the dietitians' interviews was, in some instances, quite lengthy ( $9.8 \pm 8.6$  days).
6. Some subjects may have been reluctant to provide answers for some of the variables, such as income or history of abortion, on such a brief contact with a caregiver.

Various dietary intake evaluation methods are available, their use depending on the enquirer's objectives and needs.<sup>30</sup> Diet history, the procedure used in the Higgins Method,<sup>22</sup> provides a relatively complete assessment of eating practices.<sup>31</sup> In using it, MDD dietitians focus on protein intake to assess the quality of the diet.<sup>16,17</sup> Six food-consumption variables had been planned to evaluate the mothers' protein intake. Not only did the results obtained by the use of the tool by nurses differ greatly ( $\geq 7$  g) from the actual protein intake, but, more importantly, they were similar at all risk-level ranges. These results emphasize the specificity of skills in the two health professions, thereby

motivating the exclusion of the food-consumption variables as part of the recommended screening tool for use by health professionals other than dietitians.

The MDD screening tool recommended as a result of this validation study is based on non-dietary variables that are indirect measures of nutritional status and need for dietary counselling. Most of these variables are recognized as pregnancy nutrition risk factors by the Institute of Medicine<sup>2</sup> and were part of the only non-validated screening tool for nutritional risk found in the literature review.<sup>19</sup> The risk factors with the highest scores on the tool are among those reported as predictive of both LBW/small-for-gestational-age babies and prematurity/preterm labour,<sup>20,21</sup> specifically prior LBW, being underweight pre-pregnancy, and insufficient pregnancy weight gain.

As expected, high levels of agreement were observed between the two methods of assessment on risk factors supported by evidence (maternal age, parity, closely spaced pregnancy, previous LBW baby, previous abortion, smoking, single or multiple pregnancy, and gestational age). Variables supported by limited data (strenuous work, pregnancy complications, serious emotional stress, and support) showed very low levels of agreement. Among these, only serious emotional stress, now including support, remains in the recommended simplified tool, while pregnancy complications are now part of the health-status-illnesses variable.

The level of agreement was not as high as expected on variables known to be associated with nutritional status and/or pregnancy outcome (income, pre-pregnancy illnesses, pre-pregnancy weight, weight change, drinking, drug use, and absent father). Of particular concern are the high weighted pre-pregnancy weight and weight-change variables (Kappa values of 0.34 and 0.28, respectively). As being underweight pre-pregnancy is very closely associated with LBW,<sup>2,22,29,32-34</sup> its identification is crucial to the determination of the risk level in pregnancy. In the validation study, nine subjects identified as being underweight before pregnancy by MDD dietitians were not identified as such by CLSC nurses. As well, both weight loss and low weight gain during pregnancy are nutrition risk factors.<sup>2,22</sup> Data on weight change depend, at least in part, on the accuracy of pre-pregnancy weight assessment. The relatively low level of agreement on these variables underlines the difficulty in assessing them, as well as the need to focus on training users of the tool on these particular issues. Agreement between the two "assessors" or "judges" on many variables would have been at higher levels if the study time frame had included minimal training of the nurses, plus a period of pre-study use to enhance familiarity with the tool. Thus, training, particularly on the crucial weight variables, would

further enhance the reliability of the tool in identifying a pregnant woman's nutritional risk.

Income data in the validated tool is based on MDD's yearly updated budget figures to meet basic needs in the Montreal area.<sup>24</sup> The use of the tool in other areas would necessitate adjustments of income data according to local cost of goods and services.

It is also recommended to proceed only when the necessary professional resources are available to provide nutritional counselling, as it would be unethical to screen for nutritionally at-risk pregnancies if it is not possible to follow-up with a dietitian's services. Although all low-income pregnant women would benefit from a dietitian's counselling, it is not equally available on CPNP project sites.

## **CONCLUSION**

The MDD simplified screening tool shows very satisfying reliability, sensitivity, specificity and positive predictive value in identifying the level of nutritional risk in comparison with risk levels identified through the comprehensive approach of the Higgins Method.

Hence, the nutritionally at-risk pregnant women most likely to benefit from a dietitian's intensive intervention will be identified by use of this tool.

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