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Validation of the ‘EPICES’ social deprivation score in a population of women who have just given birth: a French cross-sectional study

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Abstract

Objectives: To assess the diagnostic performance of the EPICES score for identifying social deprivation during pregnancy in a population of women in the immediate postpartum period.

Study design: This cross-sectional survey took place between 05 June and 05 August 2017, among women who had just given birth in either of the maternity units in Clermont-Ferrand, France.

Methods: A self-administered questionnaire was completed by women. The questionnaire came in two parts: the EPICES index and the criteria for social deprivation defined by French law. These criteria were chosen to define the reference standard. The women were classified in two groups, living in precarious circumstances or not, according to the criteria defined by the French law (reference standard). To determine the most relevant threshold of the EPICES score, the precision associated with the threshold (the fraction of those predicted positive who are true positives: positive predictive value) was balanced with its sensitivity. EPICES scores above the threshold were classified as deprived, those below as non-deprived.

Results: Of the 947 women who gave birth during the study period, 700 (73.9%) completed the self-administered questionnaire. The best trade-off between precision and sensitivity was obtained with a threshold of 22. For this threshold value, the positive predictive value was 42.3% and the sensitivity 70.3%.

Conclusions: The EPICES score with a threshold validated in the population of pregnant women is a useful, rapid and easy to use tool that makes it possible to identify maternal deprivation at an individual level.

Key words: social deprivation, EPICES score, pregnancy, threshold

Introduction

Several studies have established an association between social deprivation and adverse perinatal outcomes.¹⁻⁸ Social deprivation has been measured with indices constructed by small geographic areas.^{2,3,9,10} They describe the associations between the characteristics of the residential area, its match to the geographic availability of care and health-care facilities, while trying to control for the role of socioeconomic factors in the analysis of the local environment's effects on its inhabitants' health with consistent results about the prevalence of deprivation.⁸ These indices, generally global, are on the whole poorly adapted to mother-child pairs. Other indices have been created from essentially economic data that do not take into account the social dimension of deprivation, as defined by Wresinski as the lack of one or more securities enabling people to assume their elementary responsibilities and enjoy their fundamental rights.¹¹ Thus the concept of deprivation appears to be multidimensional and may be difficult to be defined. In France, an individual score of social deprivation was developed in 2002 and called the EPICES index (Evaluation de la Précarité et des Inégalités de santé dans les Centres d'Examen de santé, Evaluation of Deprivation and Inequalities in Health Examination Centers) . This reliable index, validated on cohort of 197 389 persons, is composed of 11 questions regarding material, psychosocial and social problems.¹²⁻¹⁴ It has been used in several studies but very little among pregnant women.^{15,16} In one study of women with gestational diabetes, with EPICES score greater than 30.17 (validated threshold), had more complications.¹⁵ Another study found that prenatal care was poorer among women with higher EPICES scores and that the three principal causes of unfavourable pregnancy outcomes (preterm delivery, gestational diabetes and pregnancy-related hypertension) were more frequent among women in precarious situations.¹⁶

Nonetheless these studies have mainly targeted subpopulations already at risk among pregnant women. Moreover, the threshold of deprivation used in these studies was that established at

the initial validation study of the EPICES score, conducted in a population consulting at a health insurance care centre.^{13,14} Consequently, the prevalence of deprivation among pregnant women in the general population is not well estimated, mainly because most estimates use only economic indicators. The hypothesis of our study is that the threshold for identifying women in social vulnerability is different from that determined in a population consulting in a national health insurance health care centre.

Our principal objective was to assess the diagnostic performance of the EPICES score for identifying social deprivation during pregnancy in a population of women in the immediate postpartum period.

Materials and methods

Study design

This cross-sectional survey was carried out between 05 June and 05 August 2017, among women who had just given birth in either of the maternity units (one public level III and one private level II) in Clermont-Ferrand, France.

A medical practitioner (obstetrician or midwife) informed women about the study, distributed the questionnaire and collected it each day during the study period in the postpartum units, before women were discharged.

Study Population

Women were eligible if they were older than 18 years old, spoke and read French fluently, and had provided written informed consent to participate. Women with terminations of pregnancy for medical indications were not included.

Questionnaire

A questionnaire was self-administered to participants and came in two parts: the EPICES index and the criteria for socioeconomic deprivation defined by the French law. The French law in article 2 of the decree of 1992 defined deprived populations as young people aged 16 to 25 years old excluded from the school system in a process of professional integration, unemployed, beneficiaries of the active solidarity income, people on solidarity employment contracts or consolidated employment contracts, homeless (1998), and beneficiaries of universal health coverage (for very low-income individuals) (2000).¹⁷ These criteria were chosen to define the reference standard in our study because they create eligibility for social rights and a specific pathway for care for the population recognised as deprived in France.

The EPICES index is composed of 11 binary items on marital status (1 item), health insurance status (1 item), economic status (3 items), family support (3 items) and leisure activities during the last 12 months (3 items) (supplementary file 1). The EPICES score is calculated by adding the coefficient for question to the intercept whenever the answer is “yes”. It ranged from 0 to 100, from the lowest to the highest level of deprivation.

Statistical analysis

Categorical data are presented as frequencies and percentages and continuous variables as means and standard deviations (SD). The distribution of the EPICES score was also evaluated using quintiles, the first quintile (Q1), corresponding to the least deprived women, to the fifth quintile (Q5) for those most deprived. The quintiles used were those already used in the literature as the distribution of the score is the same since scoring was established following the initial quotation.¹³

The women were classified in two groups: living in precarious circumstances or not, according to the criteria defined by the French law (reference standard). These groups were

compared using Chi-square or Fisher's exact tests for categorical variables, Student's t tests for normally distributed continuous data and Mann-Whitney non-parametric tests otherwise.

To determine the most relevant threshold of EPICES score to discriminate women according deprivation, precision and recall curve was used as the groups were imbalanced in order to display the trade-off between precision and sensitivity (also called recall) over all possible test threshold values.¹⁸ The precision associated with the threshold (the fraction of those predicted positive who are true positives, that is, the positive predictive value, PPV) was balanced with its sensitivity (= recall: fraction of true positives who are predicted to be positive). If no threshold simultaneously achieved good sensitivity and good precision, then we assessed a threshold that identified a subset of situations with a higher-than average rate of being at risk for deprivation. Figures were plotted showing both enrichment (ratio of the precision associated with the threshold to the mean positive rate) and sensitivity as functions of the threshold.¹⁹

Then we evaluated the results of the threshold by studying the confusion matrix. Women with EPICES scores above the threshold were classified as deprived, those below as non-deprived. All analyses were performed using R software (R 4.0.2, ggplot2, ROCR, and grid packages) and conducted at a two-sided $\alpha=0.05$ significance level.

Results

Of the 947 women who gave birth during the study period, 700 (73.9%) completed the self-administered questionnaire. According to the reference standard (social deprivation defined by the French law) 145 of these 700 women, that is, 20.7%, were classified as deprived.

The socio-demographic characteristics of participants are presented in Table 1. The mean age of the participants was 32.5 years (± 5.0), 52.3% had at least post-secondary education, 95.3%

were living with a partner, and 79.3% were born in metropolitan France. The mean preconception BMI was 23.7 (\pm 5.4) and 15.0% were nulliparous. The characteristics of pregnancy and delivery are described in Table 2. We note that 35.4% had a pregnancy-related disorder, that the mean term at delivery was 39.4 (\pm 2.2) weeks, and that 16.4% had a caesarean delivery. The new-born characteristics are presented in Table 3. Mean birth weight was 3256.4 g (\pm 508.4) and 48.4% of the infants were being exclusively breast-fed at discharge (Table 3).

Deprived women according to the reference standard were compared to non-deprived ones. Deprived women were younger ($P=0.0003$), had a lower educational level ($P<0.0001$), and were more often unemployed ($P<0.0001$), more often lived alone ($P<0.0001$), , and more often born abroad ($P<0.0001$). The proportion of obesity ($BMI>30 \text{ kg/m}^2$) was higher among deprived women ($P=0.003$). They had smoked more frequently at the beginning of their pregnancy ($P=0.04$). Finally, the proportion of multiparous was higher among them ($P<0.0001$) (Table 1). The women socially deprived had more frequent pregnancy-related disorders ($P=0.009$) and more preterm births ($P=0.005$) (Table 2). Non-deprived mothers had small-for-gestational-age infants ($P=0.01$) more frequently compared to deprived ones, and breastfed more often ($P=0.01$) (Table 3).

The EPICES index was compared between deprived and non-deprived groups (Table 4). The mean EPICES score was significantly higher in the deprived group ($P<0.0001$). The distribution between the two groups in quintiles varied significantly: in the non-deprived group, 65.7% of the women had a score in the first two quintiles (i.e., the lowest EPICES scores), while in the deprived group, 61.4% had a score in the last two quintiles (i.e., the highest EPICES scores) ($P<0.0001$). Distributions of the items of the EPICES index were significantly different between deprived and non-deprived groups ($P<0.0001$). More specifically, more than 50% of deprived women did not have leisure activity including

physical activity and more than 80% of them were not homeowner. Finally, nearly half of the deprived women had financial difficulties during the month. For non-deprived women, less than 30% of them were in those situations (no leisure activity, not owner and financial difficulties).

The best trade-off between precision and sensitivity was obtained with a threshold of 22 (Figures 1 and 2). For this threshold value, the sensitivity was 70.3% and the positive predictive value 42.3% (Table 5).

Discussion

Our study enabled us to validate a threshold score for the EPICES index to use during pregnancy. A sensitivity of 70% was obtained for a threshold value of 22. This sensitivity is lower than that calculated during the initial validation of the EPICES score, which was 80%. This difference is probably due to the score's initial validation within a specific population.¹³ more than 20% of the deprived women according to the reference standard had a score lower than 30.17; this may be associated with their greater social and family isolation. That is, the women defined as deprived more often lived alone;^{7,11} questions about the family environment on the EPICES score therefore had a greater weight in the calculation of the score in this population of mothers.

To our knowledge, the criteria of internal and external validity of other deprivation indices have never been compared with an administrative reference standard. The other social deprivation indices explore the marital situation but not the family structure or the social fabric of precarious populations.^{2,3} That is, geographic indices are based on ecological data about the neighbourhood, which makes it difficult to take their individual variability into

account.^{6,9,10} Most economic indicators consider household income but not the number of household members nor their family relationships.¹¹

The deprived population in our sample presents the same social and demographic characteristics already described among this population: they are younger, less educated, and more often born abroad.^{20,21} They are also more often obese and active smokers.^{22,23}

Their pregnancies more often had related diseases, especially diabetes, and they tended to give birth at a lower gestational age. Few differences were observed between the two groups for neonatal outcome. The higher rate of preterm deliveries among deprived women is an unfavourable outcome already described in the literature,^{2,8,9} as is the clear association between pregnancy-related diseases and social deprivation.^{15,24} Among these diseases, gestational diabetes nonetheless appears more frequent among these women in other studies than in ours.^{4,25}

A difference between our results and the literature^{6,8,10} is that we did not observe a higher frequency of fetal growth restriction in the deprived population. These results must be interpreted with caution and are one of our study's limitations: because these events are rare, the number of individuals affected is very low. Our study probably lacks the power to be able to explain the associations between maternal and neonatal outcomes and social deprivation.

Similarly, because this was a written questionnaire, women who did not speak French or were unable to read could not participate, and this group probably included women in the most precarious situations, for whom particular attention is necessary. It is not possible to know how many women were eligible for our study and how many refused to participate. Our participation rate is nonetheless high.

The EPICES questionnaire has already been used in telephone or face-to-face interviews; its acceptability among the respondents was good and the results about the prevalence of social deprivation consistent with ours.^{4,26}

Calculation of the EPICES score as part of a prenatal interview can therefore be envisioned for early screening of deprivation and specific management for it. In France, the early prenatal interview is the first session of preparation for childbirth and parenting. It is recommended that these interviews be planned with a midwife or physician, from the beginning of pregnancy, starting at the fourth month, either alone or with the partner. This interview is fully covered (100%) by the French national health insurance fund. Among other things, it makes it possible to identify situations of social deprivation among both mothers and fathers and has been mandatory since May 2020,²⁷ just like the 7 visits (for a full-term pregnancy) of medical antenatal care.

In conclusion, the EPICES score with a threshold validated in the population of pregnant women is a useful, rapid and easy to use tool that makes it possible to identify maternal social deprivation at an individual level. The routine use of this questionnaire during pregnancy would make it possible to study the consequences of deprivation on maternal and fetal health status.

Ethical approval

The relevant CPP ethics committee (Patient Protection Committee, Southeast 3, no. 2017-012B) approved this study.

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None

Competing interest

None

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Table 1 Social and demographic characteristics of participants in the immediate postpartum, **in the overall study population and** in deprived and non-deprived groups as defined by the French law.

	Total N=700 % [m±SD]	Deprived N=145 n% [m±SD]	Non-deprived N=555 % [m±SD]	<i>P</i> value
Age				
	[32.5 ± 5.0]	[31.5 ± 5.5]	[32.8 ± 4.8]	0.008
< 25 years	4.6	10.3	3.1	0.0003
25-39 years	87.6	79.3	89.6	
≥ 40-39 years	7.9	10.3	7.2	
Criteria of social deprivation, as defined by the French law				
16 to 25 years old excluded from school system in a process of professional integration	2.3	11.0	0	-
Receives unemployment allocations	8.0	38.6	0	-
Beneficiary of Active Solidarity	8.0	38.6	0	-
Income				
Has a solidarity employment contract	0.1	0.7	0	-
Beneficiary of universal health coverage (for the very low income)	12.0	57.9	0	-
Educational level	n= 658	n= 131	n= 527	<.0001
None or only primary school	1.2	3.8	0.6	
Middle school	15.2	35.1	10.3	
High school	31.3	35.9	30.2	
Post-secondary education	52.3	25.2	59.0	
Working during pregnancy	n= 669	n= 140	n= 529	<.0001
Worked	76.8	32.1	88.7	
Unemployed	5.1	16.4	2.1	

Homemaker	12.0	35.7	5.7	
On maternity leave	0.2	0.0	0.2	
Student	2.1	5.0	1.3	
Other	3.9	10.7	2.1	
Living status	n= 685	n= 142	n= 543	<0.0001
With a partner	95.3	85.9	97.8	
Alone	4.4	13.4	2.1	
Other	0.3	0.7	0.2	
Country of birth	n= 600	n= 130	n= 470	<0.0001
Metropolitan France	79.3	53.9	86.4	
Europe	5.2	6.2	4.9	
North Africa	6.7	13.1	4.9	
Africa	2.5	6.2	1.5	
French overseas departments and territories	3.7	13.9	0.9	
Other	2.7	6.9	1.5	
BMI (kg/m²)	n= 699	n= 145	n= 554	
	[23.7± 5.4]	[24.7 ± 6.9]	[23.5 ± 4.9]	0.04
<18.5	6.9	10.3	6.0	0.003
18.5-24.9	60.4	48.3	63.5	
25-29.9	21.9	24.8	21.1	
≥ 30	10.9	16.6	9.4	
Smoked at the beginning of pregnancy	n= 655	n= 140	n= 515	0.04
	14.5	20.0	13.0	
History of disease	n= 690	n= 144	n= 456	0.26
	29.6	33.3	28.6	
Parity				<0.0001
0	15.0	9.0	16.6	
1	33.7	23.5	36.4	
≥2	51.3	67.6	47.0	

Table 2 Characteristics of pregnancy and delivery of women in the overall study population and in deprived and non-deprived groups as defined by the French law

	Total	Deprived	Non-deprived	<i>P</i> value
	N=700	N=145	N=555	
	n %	n %	n %	
	[m±SD]	[m±SD]	[m±SD]	
Type of pregnancy	n= 696	n= 144	n= 552	0.34
Singleton	98.4	99.3	98.2	
Pregnancy-related disorders	n= 678	n= 138	n= 540	0.009
Gestational diabetes	35.4	44.9	33.0	
	n= 676	n= 138	n= 538	0.06
Hypertension	10.2	14.5	9.1	
	n= 676	n= 138	n= 656	0.96
Preeclampsia	3.0	2.9	3.0	
	n= 686	n= 139	n= 547	
Number of consultations	0.9	0.7	0.9	
	n= 481	n= 118	n= 363	
	[9.0 ± 3.7]	[9.7 ± 4.3]	[8.7 ± 3.4]	0.03
<8	29.7	30.3	29.5	0.88
≥8	70.3	69.8	70.5	
Term at delivery (weeks of gestation)				
	[39.4 ± 2.2]	[39.1 ± 1.5]	[39.5 ± 2.3]	0.007
< 37	4.6	5.5	4.3	0.005
≥37 - ≤40	73.9	82.8	71.5	
>40	21.6	11.7	24.1	
Mode of delivery				0.55
Caesarean	16.4	19.3	15.7	
Operative vaginal delivery	14.4	13.1	15.7	
Vaginal delivery, spontaneous	69.1	67.6	69.6	

Table 3 Medical characteristics of newborns in the overall study population and in deprived and non-deprived groups as defined by the French law

	Total	Deprived	Non-deprived	<i>P</i>
	N=710	N=146	N=564	value
	n %	n %	n %	
	[m±SD]	[m±SD]	[m±SD]	
Preterm birth (<37 weeks of gestation)	5.1	5.5	5.0	0.80
Sex				
Female	51.1	49.3	51.6	0.62
Birth weight				
	[3256.4 ± 508.4]	[3286.7 ± 492.9]	[3248.5 ± 512.4]	0.42
< 2500 g	6.3	6.2	6.4	0.45
≥2500-<3500 g	62.5	58.2	63.7	
≥3500 g	25.6	30.8	24.3	
≥4000 g	5.5	4.8	5.7	
Small for gestational-age *	6.3	2.1	7.5	0.02
One-minute Apgar score	n= 699	n= 144	n= 555	0.63
	[8.6 ± 1.3]	[8.6 ± 1.4]	[8.7 ± 1.3]	
Five-minute Apgar score	n= 708	n= 146	n=562	0.82
	[9.6 ± 1.2]	[9.6 ± 1.1]	[9.6 ± 1.3]	
<7	2.0	1.4	2.1	0.55
≥7	98.0	98.6	97.9	
Immediate resuscitation	n= 702	n= 143	n= 559	0.14
	6.4	9.1	5.7	
Milk source at discharge	n= 680	n= 139	n= 541	0.005
Breast milk exclusively	48.4	44.6	49.4	
Mixed	11.0	18.7	9.1	
Artificial	40.6	36.7	41.6	

* Birthweight below the 5th percentile according to the gestational age and sex

Table 4: Distribution of the EPICES items and score in the overall study population and in deprived and non-deprived groups as defined by the French law

	Total N= 700 n (%) [m±SD]	Deprived N=145 n (%) [m±SD]	Non-deprived N=555 n (%) [m±SD]	<i>P</i>
EPICES score	[19.4±18.3]	[36.1 ± 20.3]	[15.0±15.0]	<0.0001
Quintile of EPICES score				
1	26.9	5.5	32.4	<0.0001
2	30.0	17.2	33.3	
3	17.7	15.9	18.2	
4	18.3	35.9	13.7	
5	7.1	25.5	2.3	
Items of the EPICES index				
Sees a social worker (Yes)	8.9	22.8	5.2	<0.0001
Has supplementary health insurance (No)	16.6	29.7	13.2	<0.0001
Lives with partner (No)	3.7	13.8	1.1	<0.0001
Owns residence (No)	43	82.1	32.8	<0.0001
Financial difficulties during the month (Yes)	27.1	45.5	22.3	<0.0001
Practices sports activity in the last 12 months (No)	38.4	58.6	33.2	<0.0001
Attends live arts performances in the last 12 months (No)	44.7	69.7	38.2	<0.0001
Takes vacations during the past 12 months (No)	29.7	53.8	23.4	<0.0001
Contact other than close family in the past 6 months (No)	5.9	13.1	4.0	<0.0001
Possibility of housing by family or friends for a few days (No)	4.1	13.1	1.8	<0.0001

Material help from family or friends (No) 4.9 15.2 2.2 <0.0001

Table 5 Ability of the EPICES score to discriminate between deprived women and non-deprived with social deprivation defined by the French law

Social deprivation defined by the EPICES index *	Social deprivation defined by the French law		
	Deprived	Non-deprived	Total
Deprived	TP 102	FP 139	241
Non-deprived	FN 43	TN 416	459
Total	145	555	700

* Deprived for EPICES score ≥ 22 ; non-deprived for EPICES score < 22 .

TP=true positive; FP=False Positive; FN=False negative; TN=True Negative

Figure legends

Figure 1: Ratio of the precision associated with the threshold to the mean positive rate: enrichment.

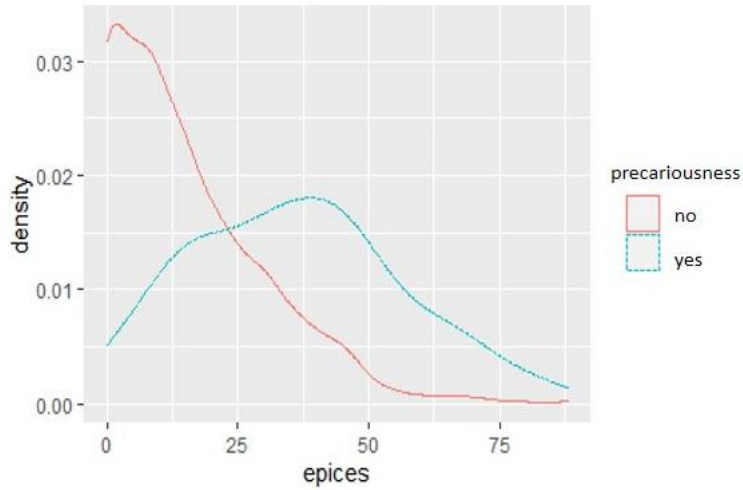
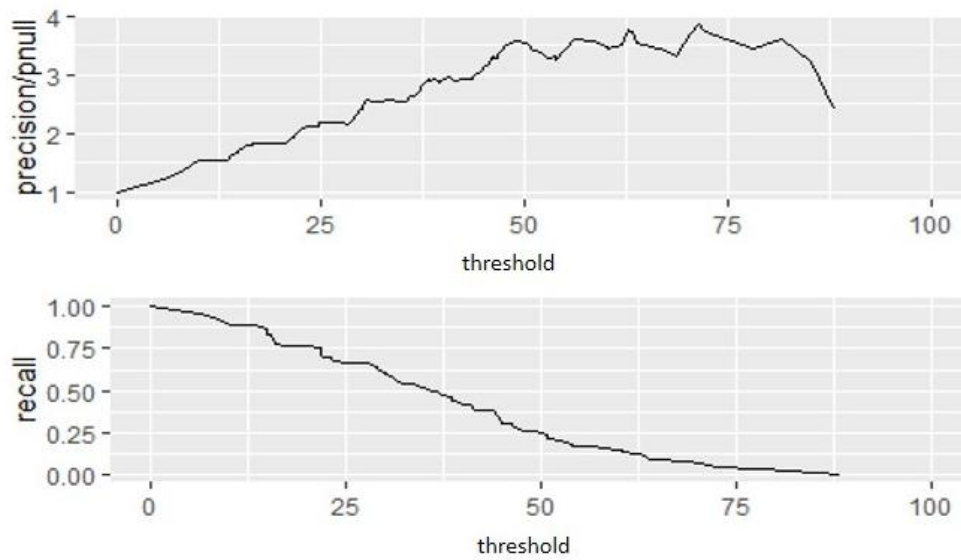


Figure 2: Sensitivity analysis as functions of the threshold of the EPICES score



Supplementary file 1 : EPICES index (Evaluation de la Précarité et des Inégalités de santé dans les Centres d'Examens de Santé - Evaluation of Deprivation and Inequalities in Health Examination Centres

Items	Yes
1. Do you sometimes meet with a social worker (welfare worker, educator)?	10.06
2. Do you have complementary health insurance (mutual insurance)?	-11.83
3. Do you live as a couple?	-8.28
4. Are you a homeowner or will you be one in the near future?	-8.28
5. Are there periods in the month when you have real financial difficulties in facing you needs (food, rent, electricity)?	14.80
6. Have you participated in any sports activities in the last 12 months?	-6.51
7. Have you gone to any shows (cinema, theatre) in the last 12 months?	-7.10
8. Have you gone on holiday during the past 12 months?	-7.10
9. Have you seen any family members in the past six months (other than your parents or children)?	-9.47
10. If you were in difficulty (financial, family or health), is there anyone close to you who could take you in for a few days?	-9.47
11. If you were in difficulties (financial, family or health), is there anyone close to you who could help you financially (material aid such as lending you money)?	-7.10
Intercept	75.14

If answer to the item is « yes », the corresponding coefficient is added to the intercept. The EPICES score range from 0 (absence of social deprivation) to 100 (the highest level of deprivation).