



Construction and Validation of an Individual Deprivation Index: a Study Based on a Representative Cohort of the Paris Metropolitan Area

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Abstract The association between health status and deprivation is well established. However, it is difficult to measure deprivation at an individual level and already-existing indices in France are not validated or do not meet the needs of health practitioners. The aim of this work was to establish a validated, easy-to-use, multidimensional, relevant index that was representative of the population in the Paris metropolitan area. From the SIRS 2010 cohort study, 14 socio-economic characteristics were selected: health insurance, educational background, socio-professional category, professional status, feelings of loneliness, emotional situation, household type, income, perceived financial situation, social support (support in daily life, financial and emotional), housing situation, and migration

origin. In addition, a total of 12 health status, health-care use, and nutrition-related variables were also selected. Content validity and internal validity of the index were explored. The 14 socio-economic indicators were associated to varying degrees with poorer health status, less use of healthcare, and poorer nutrition and were distributed across the 14 multiple-choice questions of the index. Each answer was rated from 0 to 2. The index value of 10 that isolates 20% of the most deprived individuals was used as threshold. “Being deprived,” as defined with this value, was significantly associated with 9 of the 12 studied health variables. This index could be a relevant instrument in the assessment of deprivation and social inequalities of health.

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Introduction

The health status of a population is influenced by many determinants including poverty and deprivation [1]. Studying social determinants of health is often complex because a variety of factors come into play, making it difficult to appreciate the specific role of each one. Deprivation is defined as the absence of one or more forms of security, such as employment, which allow individuals and families to meet their professional, family, and social obligations and enjoy their fundamental rights [2]. This concept also refers to an accumulation of unstable living conditions that can lead to a gradual deterioration of social bonds that provide support and recognition in different spheres of socialization: family, professional environment, neighborhood, network of friends [3]. It is associated with increased risks of morbidity and mortality and can lead to low birth weight [4], extreme prematurity [5], cardiovascular diseases [6], mental health [7, 8], respiratory diseases [9], or cancers [10, 11]. When it comes to cancer, it is also associated with a delay in diagnosis and subsequent poor prognosis [12] such as less access to healthcare institutions, less compliance with treatment, but also less adherence to screening campaigns [13–17].

There are two main types of indices for measuring social inequalities in health: ecological indices and individual indices. Ecological indices make it possible to describe links between activity occurring in a territory and the health of its residents, the geographical locations of healthcare, and the adequacy of services, and to control for the role of socio-economic factors when analyzing how the local environment can impact the health of inhabitants. Such indices exist in several countries, including the USA [18–20], Canada [21], Japan [22], Italy [23, 24], Spain [25], and Belgium [26]. Many studies suggest that living in a poor neighborhood can have a negative effect on health independently of individual characteristics [27–30]. However, because these indices cannot detect and measure deprivation at an individual level, they are not suitable for primary care.

In individual indices, the statistical unit is the individual. For each individual belonging to a defined population, a series of varied information is collected (e.g.,

pathology, date and cause of death, occupation, monthly income), and the link between these variables at the individual level is studied. Several epidemiological indices are used throughout the world, such as the New Zealand index NZiDep [31], the Swiss index DiPCare-Q [32], or the Turkish index FWID [33]. Still, these indices cannot be transposed to the French population because of differences in terms of social and cultural habits. To our knowledge, three main individual indices of deprivation exist in France: the index established by Jean Pascal [34], the social handicap index [35–37], and the EPICES index [38]. However, none of these indices have been validated. The first two are not commonly used, the last being the most widely used of the three in France. The EPICES index [38] provides a multidimensional point of view by covering material and social determinants of deprivation, which it bases on 11 binary questions. Although this index is very sensitive, its specificity is not very high [39]. Another major weakness of this index is that it dates from 2002 and some of its questions are now obsolete, difficult to ask in a primary care context, and not very robust to societal changes. If we take the example of the question “Have you been to a show (cinema, theater, etc.) in the last 12 months?” in the current context of the COVID-19 pandemic, all individuals, regardless of their level of insecurity, will answer “no” and will be scored as “deprived” for this item. A validated individual deprivation index would both provide a tool for measuring deprivation in epidemiological studies and aid in the identification of at-risk patients in the context of primary care.

When developing an index (health status questionnaire), the quality criteria used to assess the methodology include content validity, internal consistency, criterion validity, construct validity, reproducibility, longitudinal validity, responsiveness, floor and ceiling effects, and interpretability [40].

The objective of this first work was therefore to develop and validate a French standardized index of individual socio-economic deprivation.

Material and Methods

Study Sample

The population was drawn from the 2010s wave of the SIRS study (*Santé Inégalités Ruptures Sociales*, “Health, Inequalities, and Social Ruptures”), which is the most recent wave available to date. The sample was

representative of French-speaking adults (≥ 18 years old) living in the Paris metropolitan area. A total of 3006 people were included between December 2010 and December 2011 through a multistage cluster sampling procedure. First, 50 census blocks called “IRISs” were randomly selected from the 2595 eligible in the Paris metropolitan area. IRISs (French acronym for blocks for incorporating statistical information) constitute the smallest census unit areas in France and allow the use of aggregated data. Then, 60 households were randomly chosen within each selected IRISs. Third, one adult was selected within each household using the birthday method (the one whose future birthday is closest to the date of the interview). In total, of the people contacted, 29% refused to participate, and 5% were excluded because they did not speak French (3%) or because they were too sick to participate (2%). Data from the cohort were analyzed cross-sectionally and results were weighted. The methodology used is detailed at length elsewhere [41–47].

Construction of the Index and Selection of the 14 Socio-Economic Indicators

In order to build the index, working groups were organized, bringing together researchers working in the field of social inequalities in health such as epidemiologists or sociologists. Based on dimensions found in the literature to be associated with social insecurity and by consensus of these experts, a set of fourteen indicators was therefore selected from the entire SIRS survey. Each socio-economic indicator could have two to five possible answers, but only one could be chosen. Points were assigned to each answer (0 to 3 points), with the maximum value assigned to the most deprived situations and the minimum value to the least deprived. The final index value was the sum of the different points and could range from 0 to 27. The index is presented in Fig. 1.

For the different combinations that pertain to health insurance coverage, we defined four main categories: (a) Social Security (“*Sécurité Sociale*”) combined with a complementary private health insurance plan, (b) universal health insurance coverage (*CMU-C*) or *State Medical Aid (Aide Médicale d’Etat, AME)*, (c) Social Security without complementary health insurance, and lastly, (d) no health insurance coverage. In France, “social security” refers to the public health insurance for documented residents and it reimburses between

60 and 70% of main health expenditures. “Universal health coverage” (“*Couverture Maladie Universelle*”) refers to health insurance coverage that covers all of out-of-pocket expenses for people with financial resources below a given threshold. State medical aid (“*AME*”) is the insurance for undocumented individuals that reimburses 100% of most care.

Variables related to socio-economic status were education level, declarative monthly household income, and socio-occupational group (job category and professional status). Education level was defined as the highest educational attainment achieved by an individual participant and categorized into three standard hierarchical groups: none or primary education (up to approximately 6 years of education), secondary education (up to approximately 12 years), and tertiary education (bachelor’s degree or higher). Income was defined as a binary variable and was based on the amount of money a household had per month: more than 910 euros or 910 euros and less (910 euros corresponds to the poverty line at the time of the survey). Job category was defined according to the classification of the French National Bureau of Statistics as followed: executives/managers, tradespeople/shopkeepers/intermediate occupations, workers/employees, or never having worked for more than 3 months; the retired or unemployed were classified according to their last job [48]. Professional status was defined as being employed, a student, unemployed (with or without unemployment benefits), retired, or inactive (e.g., disabled). We classified as employed those individuals who answered that they help a member of their family in their work (even without being paid), those on annual leave, sick leave, maternity leave, individual training leave, professional reconversion leave, exemption from activity, student civil servants, temporary workers, and casual entertainment workers.

Variables related to social support were feelings of loneliness (feeling very lonely, rather lonely, rather surrounded, or very surrounded), emotional situation (being in a relationship and living with a partner, being in a relationship but not living with their partner, having a significant romantic relationship, or not being involved in a romantic relationship), having someone to turn to for material/financial and emotional/moral support in case of difficulties and human help in daily life (social support: for example, having help to go somewhere, someone to do some minor work at home, to look after someone’s children).

Fig. 1 PRECAR index of deprivation, from the 14 selected indicators, SIRS study 2010. For each item, 2 to 5 answers were possible and between 0 and 3 points were awarded. Source: SIRS study, 2010

<p>1. What is your social security coverage?</p> <p>Benefit from Social Security and a complementary health insurance 0 points Benefit from complementary CMU, or from the Aide Médicale de l'Etat 1 point Benefit from Social Security alone, or from CMU alone 2 points Have no health coverage 3 points</p> <p>2. What is your educational background?</p> <p>Never been to school, or last class attended was during primary education 2 points Last class attended was in lower or upper secondary education (6th to 12th grade) 1 point Have attended higher education 0 points</p> <p>3. Which socio-professional category do you belong to?</p> <p>Am or have been a member of the management and higher intellectual professions 0 points Am or have been in the intermediate professions, am or have been a craftsperson, shopkeeper, or company director 1 point Am or have been an employee or manual worker 2 points Have never worked for more than three months 1 point</p> <p>4. What is your professional status?</p> <p>Am employed: 0 points <i>All of the following are considered being employed:</i></p> <ul style="list-style-type: none"> • those who help a family member in their work, even if they are not paid, • those on annual leave, sick leave, maternity leave, individual training leave, conversion leave, exemptions from activity, etc. • student civil servants, temporary workers, entertainment workers <p>Am a student. 0 points Unemployed (registered or not with the ANPE / Pôle Emploi) 2 points Retired 1 point Am inactive (e.g., disabled) 1 point</p> <p>5. Generally speaking, would you say that you feel?</p> <p>Very lonely 3 points Rather lonely 2 points Somewhat surrounded 1 point Very surrounded. 0 points</p> <p>6. What is your emotional situation?</p> <p>Not in a significant romantic relationship. 3 points Have a significant love or romantic relationship, but do not consider ourselves to be in a couple 2 points Am in a couple but not living with my partner 1 point Am in a couple and living with my partner. 0 points</p>	<p>7. Who do you live with?</p> <p>One person 1 point Mononuclear: couple, with or without children 0 points Single parent: single parent with child(ren) 2 points "Single": other cases (isolated) 1 point</p> <p>8. Do you earn more or less than 910 euros per month?</p> <p>More than 910 euros 0 points Less than 910 euros 1 point</p> <p>9. How do you perceive your financial situation?</p> <p>I am comfortable 0 points It's okay 0 points I just have to be careful 1 point I am having a hard time 2 points</p> <p>10. If you needed help, would you be able to count on someone, whether members of your household, family members, friends, colleagues, or neighbors, to help you in your daily life, to give you a hand?</p> <p>Yes 0 points No 1 point</p> <p>11. In case of need, would you be able to count on someone, be it members of your household, family members, friends, colleagues, or neighbors, to help you financially or materially (food, clothes, etc.)?</p> <p>Yes 0 points No 1 point</p> <p>12. In case of need, would you be able to count on someone, be it members of your household, family members, friends, colleagues, or neighbors, to give you moral or emotional support?</p> <p>Yes 0 points No 1 point</p> <p>13. Are you a homeowner, tenant, or lodger?</p> <p>Owner or related to the owner (household member, family member) 0 points Tenant or related to a tenant. 1 point Lodger 2 points</p> <p>14. Are you of French nationality? If yes, what nationalities are/were your parents?</p> <p>French, born of two French parents 0 points French, but at least one of the parents does not have French nationality 1 point Do not have French nationality 2 points</p>
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Variables related to living standards were housing situation, household type, and perceived financial status. Housing situation was defined as being an owner, or in connection with the owner (household member, family member), being a tenant or attached to a tenant, or being hosted. Household type categories were single person, mononuclear (couple, with or without children), single parent (single parent with a child or children), or other cases.

Participants' perceived financial status was assessed using the question: "How do you describe your financial situation in general?" The possible answers were "comfortable," "OK," "short of money," and "experiencing financial difficulties."

Finally, migration origin was defined as "French-born with both parents French," "French-born with at least one foreign parent," or "foreign-born."

Outcome Measures

Health status of the population, use of healthcare, and nutrition were characterized along several dimensions surveyed in the study.

Health Status

Indicators used to describe health status were self-perceived general, physical, and mental health, depression,

chronic disease (i.e., an illness that has lasted or may last for a period of 6 months or more), obesity, and being overweight. Self-perceived health is a self-assessment of a person's own health using a 5-point Likert scale (very good/good/fair/bad/very bad) and was defined according to the Minimum European Health Module (MEHM) [49]. The general health question was "Would you say that your health in general is very good, good, fair, poor, or very poor?"; for physical health, it was "How would you rate your physical health?"; and for mental health, participants were asked, "How would you rate your psychological health and emotional well-being?" To facilitate the statistical analyses, we dichotomized the three variables related to self-perceived health into binary categorical variables, including "very good and good" items as "good state of health" and "average, poor, or very poor" as "deteriorated" state of health. Depression was assessed using the Mini International Neuropsychiatric Interview (MINI) module related to major depression and based on the Diagnostic and Statistical Manual of Mental Disorders-IV and the International Classification of Diseases-10 criteria [50]. The MINI has been used in many studies and its validity has been well assessed. A chronic disease is one that has lasted or may last for a period of 6 months or more. Being overweight was defined as having a BMI > 25 and obesity as BMI > 30.

Healthcare Use

Indicators used to describe this dimension were not having a regular doctor, having last visited a dentist more than 2 years ago, or not having consulted a medical specialist in the last year. These three variables were binary ("yes" or "no") and the reference category for the analyses was "no."

Health Behavior Variables Related to Nutrition

Indicators used to describe this dimension were consuming fewer than 5 fruits and vegetables daily (the French recommendation is an intake of at least 5 fruits and vegetables per day) and food insecurity, which was defined as a situation where, for financial reasons, people's access to healthy, nutritional, and "socially

acceptable" food (e.g., without begging, stealing, donations, or food aid) is limited, inadequate, or uncertain [51, 52]. Food insecurity was measured using the US Household Food Security Scale (US HFSS) [53].

Statistical Analyses

First Step: Distribution of the Index Values and Definition of a Threshold

In order to determine a threshold, index value distribution was studied by subgroups. From these results, we decided to keep the value that isolates the 20% of individuals with the highest values.

Second Step: Validation of the Index

In this paper, only the results related to internal validity are presented.

Content validity was explored by analyzing associations between the 14 socio-economic indicators and the 12 health-related outcomes using logistic regression. Multivariate analyses were performed using stepwise regression. Variables were included in the final models if the Wald test significance level was less than 5%. Associations were expressed using odds ratios as well as 95% confidence intervals. For the sake of synthesis, only multivariate analyses are presented in this article.

For *construct validity*, we assessed internal validity using several methods. First, the distribution of index values was analyzed according to age and gender, as these two variables were not included in the index. Then, we studied the association between individuals classified as "deprived" on the basis of the index and the 12 health-related variables using a logistic regression method. The "deprived" variable's threshold was added as an illustrative variable.

Internal consistency was assessed with Cronbach's alpha.

The external validity, the stability of the index using a test-retest analysis, and its acceptability were assessed but not presented in this study.

All statistical analyses were performed using SAS 9.3 © software.

Results

First Step: Distribution of the Index Values and Definition of the Threshold

Description of the Study Population Characteristics

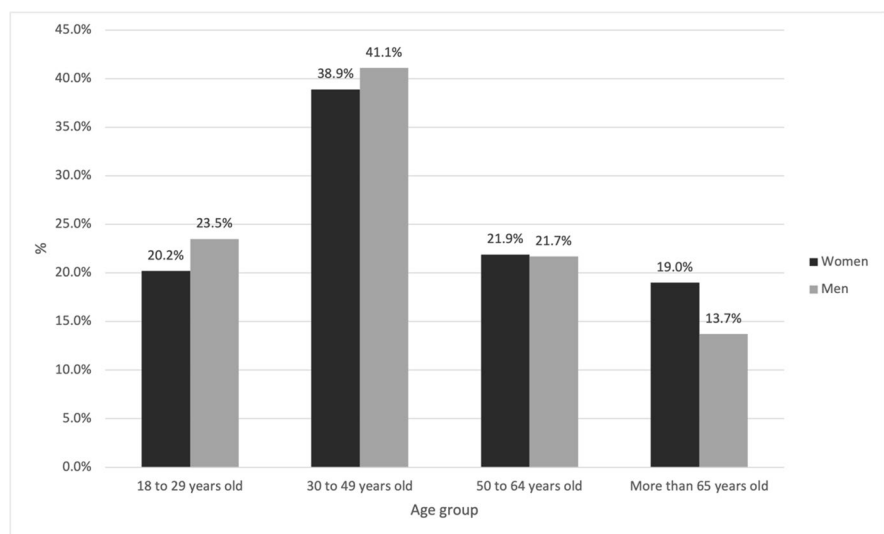
Out of 3006 participants, 46.9% (1411) were women and 53.1% (1595) men. Age was distributed as follows ($n=3006$): 21.8% were aged 18 to 29 years old, 39.9% between 30 and 49, 21.8% between 50 and 64, and 16.5% over 65 years old. Figure 2 shows age distribution by gender.

Distribution according to the 14 socio-economic indicators is presented in Table 1. Missing data were less than 5% for all analyses performed.

Deprivation Index and Its Threshold

To determine the index value at which we can establish that an individual is in a situation of deprivation, we studied the distribution of the index values by sub-groups, using the mean, standard deviation, quartiles, and the 8th and 9th deciles (see Fig. 3). From these results, we decided to keep the value that isolates the 20% of individuals in the most severely deprived situation. The value of 10 was therefore used as a threshold.

Fig. 2 Age distribution by gender, SIRS study 2010. The x -axis represents the age groups (years) and the y -axis the proportions (percentages) for women (left bar in black) and men (right bar in gray). Source: SIRS study, 2010



Second Step: Validation of the Index

Content Validity

Socio-Demographic Characteristics According to Studied Health Dimensions Associations between the 14 socio-economic indicators and the 12 deprivation characteristics were studied and are presented in the Supplementary Files.

Health status Perception of degraded general, physical, and mental health were associated with socio-economic indicators to varying degrees. They were all associated with perceived financial status, having human help in daily life, and feelings of loneliness. For feelings of loneliness, individuals who felt very lonely had higher risks of perceiving their general, physical, and mental health as degraded (adjusted odds ratio aOR = 4.04 CI95% = [2.02–8.06], 2.74 [1.40–5.38], and 9.31 [4.67–18.56], respectively). Having a chronic illness and depression were associated with fewer indicators. Experiencing financial difficulties was associated with an increased risk of chronic illness and depression (aOR 1.81 [1.27–2.57] and 4.45 [2.4–8.16], respectively). Paradoxically, individuals earning less than 910 euros per month were more protected from being overweight

Table 1 Description of the 14 socio-economic indicators chosen for the construction of the deprivation index. Source: SIRS 2010, weighted data

Socio-economic characteristics	<i>n</i>	%
Health insurance (<i>n</i> = 3003)		
Social Security and a complementary health insurance	2449	81.6
CMU or AME*	186	6.2
Social Security alone or from the CMU alone	351	11.7
No health insurance	17	0.6
Educational background (<i>n</i> = 3006)		
Primary education or less	221	7.4
Secondary education	1087	36.2
Higher education	1698	56.5
Socio-professional category (<i>n</i> = 2998)		
Higher intellectual professions	565	18.9
Intermediate professions + CSC**	907	30.4
Employee or manual worker	1275	42.7
Never have worked	241	8.1
Professional status (<i>n</i> = 2978)		
Employed	1651	55.5
Student	282	9.5
Unemployed	229	7.7
Retired	595	20.0
Inactive	220	7.4
Feelings of loneliness (<i>n</i> = 2997)		
Very lonely	47	1.6
Rather lonely	350	11.7
Somewhat surrounded	1616	53.9
Very surrounded	983	32.8
Emotional situation (<i>n</i> = 3006)		
No relationship	723	24.1
Love or romantic relationship	348	11.6
Non-cohabiting couple	165	5.5
Cohabiting couple	1770	58.9
Household type (<i>n</i> = 3006)		
One person	570	19.0
Mononuclear	1918	63.8
Single parent	278	9.2
Isolated	241	8.0
Income (<i>n</i> = 3006)		
910 euros or less	971	32.3
More than 910 euros	2035	67.7
Perceived financial situation (<i>n</i> = 2901)		
Comfortable	641	22.1
It's okay	1036	35.7
It's just, you have to be careful	898	31.0
You're having a hard time	326	11.2
General support (help you in your daily life (<i>n</i> = 2998))		
Yes	2887	96.3
No	111	3.7

Table 1 (continued)

Socio-economic characteristics	<i>n</i>	%
Financial/material support (<i>n</i> = 2990)		
Yes	2673	89.4
No	317	10.6
Moral/emotional support (<i>n</i> = 2969)		
Yes	2905	97.8
No	64	2.2
Housing situation (<i>n</i> = 2986)		
Owner or related to the owner	1504	50.4
Tenant or related to a tenant	13591	45.5
Hosted	123	4.1
Migration background (<i>n</i> = 3006)		
French, born of two French parents	2002	66.6
French with at least one parents without French nationality	626	20.8
Foreigner	379	12.6

*Complementary CMU, or from the Aide Médicale d’Etat

** Craftsman, Shopkeeper or Company director

and obese (aOR of 0.74 and CI95% = [0.60–0.90] vs. 0.67 [0.49–0.93], respectively).

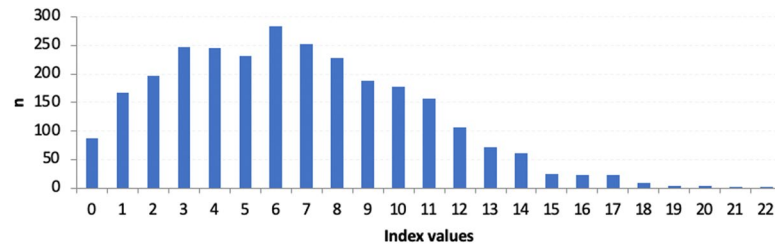
Healthcare use Having social security coverage without complementary health insurance and being isolated were associated with a higher risk of not having a regular doctor (aOR 2.11 CI95% = [1.44–3.08] and 1.78 CI95% = [1.05–3.02], respectively). Individuals with no educational attainment or with a primary education level were at greater risk of not having consulted a specialist in the last year or a dentist for at

least 2 years (1.69 [1.15–2.49] and 2.26 [1.52–3.34], respectively).

Health behavior variables related to nutrition Perceived financial status was strongly associated with nutrition, especially food insecurity. Having financial difficulties was associated with an increased risk of consuming fewer than 5 fruits and vegetables per day (2.97 [2.09–4.23]) and experiencing food insecurity (194.47 [7.86–> 999.99]).

Fig. 3 Distribution of PRECAR index values among the study population, SIRS study 2010.

The *x*-axis represents the index values and the *y*-axis the size population for each value (counts). Source SIRS study, 2010



Mean	Standard deviation	First quartile Q1	Median	Third quartile Q3	Eighth decile D8	Ninth decile D9	Minimum	Maximum
6.61	3.95	3	6	9	10	12	0	22

Each of the 14 variables was significantly associated with at least 3 health determinants, except for emotional support and health insurance.

Construct Validity

Distribution of the Index Values by Population Subgroups *By gender.* Distributions of the index values were similar for men and women (see Fig. 4).

The index values were slightly higher for women as compared to men (with a mean of 6.78 and 6.42, respectively ($p < 0.05$)), and 25% of men had an index value below 3, while 25% of women had an index value below 4.

By age. Individuals aged between 18 and 29 years old had the highest index values, with an average of 8.15 (CI95% = [7.79–8.51]). Those aged above 65 years old had the next-highest index values (mean of 7.01 (CI95% = [6.70–7.32])). Individuals aged between 30 and 49 and 50 and 64 had the lowest scores, with an average of 6.02 (CI95% = [5.79–6.26]) and 5.93 (CI95% = [5.65–6.21]), respectively.

Distribution of the Index Values by Health Variable Associations between deprivation (i.e., those with an index value > 10) and the 12 health variables were studied using the logistic regression method. Results are presented in Table 2. “Being deprived” was significantly associated with 9 of the 12 health variables studied (degraded self-perceived general, physical, and mental health, depression, obesity, not having consulted a specialist during the last year, not

having seen a dentist for at least 2 years, consuming fewer than 5 fruits and vegetables daily, and food insecurity).

Internal Consistency

The Cronbach’s alpha value was 0.68.

Discussion

Main Results

The analysis presented in this work was the foundation for the construction and the internal validation of a multidimensional individual deprivation index in the general population of the Paris metropolitan area, using data from the 2010 SIRS cohort. The 14 socio-economic characteristics were associated to varying degrees with deprived health status, less use of healthcare, and poorer nutrition. The 14 items of the index were therefore relevant in identifying difficult social situations that can potentially lead to consequences on health status.

Gold Standard

A questionnaire is valid if it measures what it is supposed to measure. In the case of measuring deprivation, no consensus on an objective definition of deprivation in the field of public health exists. As a result, for the external validation of the PRECAR index and in the absence of a gold standard, the problem that

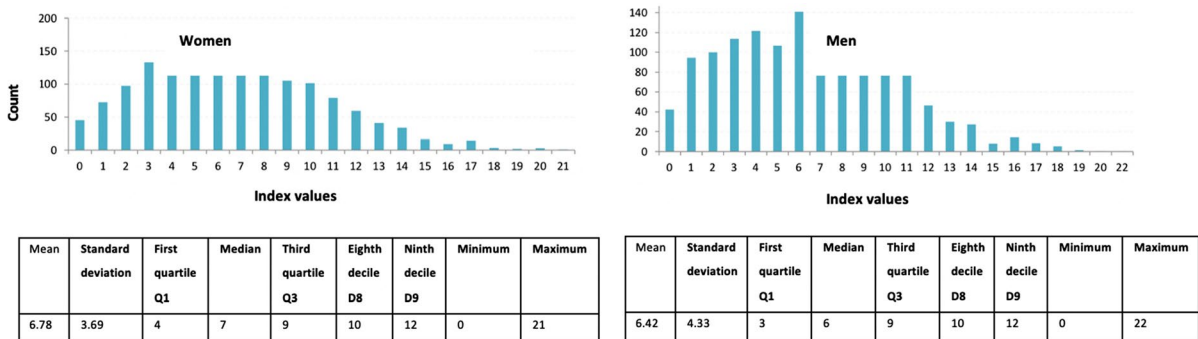


Fig. 4 Distribution of the PRECAR index values by gender, SIRS study 2010. The x-axis represents the index values and the y-axis the size (counts) for women (left) and men (right). Source SIRS 2010

Table 2 Association between being in a situation of deprivation as defined by the PRECAR index value and health variables, univariate analyses. (source: SIRS 2010, weighted data)

Health status	Degraded self-perceived general health	Degraded self-perceived physical health	Degraded self-perceived mental health	Chronic illness	Depression	Overweight	Obesity
In a deprived situation							
Yes OR (95%CI)*	3.13 (2.54–3.86)	2.57 (2.09–3.17)	3.14 (2.53–3.89)	1.07 (0.87–1.32)	3.35 (2.52–4.45)	1.16 (0.94–1.43)	1.43 (1.06–1.93)
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Health care use		Not having a regular doctor		Not having consulted a specialist during last year		Not having seen a dentist for at least 2 years	
In a deprived situation							
Yes OR (95%CI)		1.30 (0.96–1.76)		2.01 (1.64–2.45)		1.80 (1.45–2.24)	
No		Ref		Ref		Ref	
Nutrition		Consuming less than 5 fruits and vegetables daily			Food insecurity		
In a deprived situation							
Yes OR (95%CI)		3.23 (2.60–4.01)			7.43 (5.39–10.24)		
No		Ref			Ref		

*OR: Odds Ratio; 95%CI: 95% confidence interval

arises is which index to use to assess our new tool. If the EPICES index is used, some specificity will have to be considered. For example, it seems that the EPICES index overestimates the proportion of deprived individuals as mentioned in studies evaluating this index, such as the EPIDAURE-CDS project, where deprived individuals were overestimated in health centers or in hospitals [14].

Strength and Limitations

Although there are major sociological disparities among deprived individuals, this index had the advantage of considering the multiple dimensions of deprivation in multiple material and social dimensions. The notion of deprivation does not characterize a particular social category but synthesizes a multifactorial set of pejorative situations. Our index had the advantage of addressing both economic and social vulnerability by considering the different dimensions of deprivation at the individual level.

The *length of the index* was one limit of our tool, as it could be time-consuming to ask all 14 questions during a general medical consultation. However, in practice, some items can easily be grouped together, and several answers are usually already written in

the patient's file. For example, if we ask a patient their main professional activity and the answer is "school teacher," we can therefore conclude that they have higher education, belong to the executives and higher intellectual professions job category, and that they are employed. It should also be borne in mind that the result of the index could be influenced by the way in which the information is gathered. For example, a patient seen by a doctor in a time crunch may not have all the information in the file and may have limited time to ask the questions. This may induce an information bias in the sense that the result will vary depending on the person filling in the questionnaire. For this purpose, the reproducibility of the index will be the subject of a future article. To address the length issue, the next step after the validation of this first version of the PRECAR index is to create a shorter version, more adapted to the clinical setting. This version will be created by selecting from the PRECAR index the strongest items and by assessing its acceptability for patients and physicians.

Finally, the PRECAR index also had the advantage of being easy to calculate and the total points could be obtained without using a calculator.

From a methodological point of view, we can regret that the situation of deprivation was not

significantly associated with some of the health-related variables. It was neither associated with having a chronic health problem, being overweight, nor having a regular doctor. However, if we consider that our deprivation index is valid, this is ultimately rather encouraging for the primary care system in France since it could mean that deprived individuals have similar access to primary care as non-deprived individuals. Moreover, in relation to the quality criteria used to evaluate the index development methodology, our index met the content and construct validity criteria [40, 54]. A scale with a Cronbach's alpha between 0.70 and 0.90 is considered to have good internal consistency with a good correlation between the items and makes summarizing the items justified. The PRECAR index Cronbach's alpha was below but very close to this criterion.

Also, sensitivity to change was not measured. However, within the same country, the question of the "life span" of deprivation index values (and the definitions that underpin them) remains to be studied. Over long periods of time, it seems obvious that indices of disadvantage cannot remain static and defined once and for all, precisely because social norms and socio-economic contexts change. But when, for how long, and with the occurrence of which social and economic changes do they become obsolete?

Furthermore, our tool was able to predict deprivation, but not all people with an index value above 10 are necessarily in a deprived situation, and individuals with an index value below 10 may also be deprived. This concept is known as ranking bias. This ranking bias can be mitigated with the vigilance and critical discernment of a clinician when interpreting this index.

The PRECAR index is currently used by a network of therapeutic education nurses on their patients in order to better assess their level of deprivation. As stated above, the second perspective is the development of a shorter index based on this work in order to promote its use during a consultation. It would include a health literacy dimension that was unfortunately not included in this version of the PRECAR index.

The use of this index could make it possible to identify the most socially vulnerable patients and to put in place measures to eventually reduce social inequalities in health, such as providing more

consultation time or allotting time to address the social and psychological aspects. In a larger framework, measures have recently been put in place in France to help healthcare professionals fight against social inequalities in health, and this work therefore complements that momentum. For example, we can cite the recommendations issued by the Society of General Practitioners in France, which aim to raise awareness among general practitioners of the social status of patients seen in general practice. Finally, we can mention that most of the dimensions included in the PRECAR index were similar to those recommended by the US National Academy of Medicine to be collected in the Electronic Health Records [55].

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