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Abstract

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Purpose Despite their higher risk for and mortality from cervical cancer, evidence indicates low rates of cervical cancer screening (CCS) among women with obesity. The literature on the specific factors related to CCS nonadherence in this population is limited.

Methods We examined the data on 2,934 women with obesity included in the CONSTANCES survey from 2012 to 2015. Using the Andersen's behavioral model, we studied the relationships between the socioeconomic, sociodemographic, health, health personal behaviors and healthcare use related factors with CCS nonadherence. The analysis was performed using structural equation models.

Results Regular follow-up by a gynecologist, good quality of primary care follow-up and comorbidities were negatively associated with CCS nonadherence. Limited literacy, older age, being single, living without children and financial strain were positively associated with CCS nonadherence. Our results do not point to competitive care, since women with comorbidities had better CCS behaviors, which were explained by a good quality of primary care follow-up.

Conclusion Our study identified the factors that explain CCS nonadherence among women with obesity and clarified the effects of health status and healthcare use on screening. Further efforts should be undertaken to reduce the obstacles to CCS by improving care among women with obesity.

Keywords Cervical cancer screening, Obesity, Healthcare use, Health status, Competitive care, Andersen's model.

Introduction

Every year in France, 3,000 women are diagnosed with invasive cervical carcinoma and 1,100 die from this disease [1]. Cervical cancer screening (CCS) can help prevent cancer, detect precancerous cervical lesions and permit early detection of cancer. In France, Pap test-based CCS is recommended every three years for women aged 25 to 65 years after two normal results in a row one year apart. Although nine in ten cases of cervical cancer could be prevented with screening, 40% of the targeted women did not have a Pap test during the period from 2010 to 2014 [2].

Women with obesity, whose prevalence is on the rise worldwide and who account for 15.6% of French women [3], are one of the groups who are particularly concerned by low CCS rates [4, 5]. According to their elevated risk of and mortality from cervical cancer [4], it appears important to understand why CCS recommendations are not reaching these women.

Based on the literature, several patient- and health care provider-related barriers to CCS exist for women with obesity. Some barriers are reported in the general population (*e.g.* low socioeconomic status) but do not fully explain their lower participation in CCS [4, 5]. Women with obesity also have to face specific barriers. Indeed, multiple weight-related barriers may lead women with obesity to delay or avoid CCS. This includes embarrassment, negative body image and problems with inadequate medical equipment [4-6]. Healthcare providers also reported difficulty in managing patients with obesity, including lack of knowledge regarding how to overcome the reluctance of the women to get CCS and difficulty in doing pelvic examination itself [4, 5]. Weight stigma in medical care may reduce the quality of

care for women with obesity and discourage them to seek care due to healthcare providers' negative attitudes [4, 5, 7, 8]. In addition to these weight-related barriers, obesity and in particular obesity-related comorbidities may hinder preventive care because of competing demand, relying in particular on the fact that management of obesity and comorbidities requires more time than that available to the general practitioner. In contrast, two studies showed that time spent with the provider was not significantly associated with obesity [9, 10] and another one found that women with obesity received provider recommendations for Pap test as likely as women with normal weight [11]. Furthermore, a recent meta-analysis reported mixed results for the association between comorbidity and participation in CCS [12]. Lastly, women with obesity visit a general practitioner more often than women with a normal weight [13, 14] while in parallel consulting a general practitioner is associated with better screening in general population [15, 16]. There is a need to elucidate the complex mechanisms between women's health (including obesity-related health characteristics such as obesity severity, waist size and obesity-related comorbidities), healthcare use (including the control of obesity-related comorbidities) and CCS participation among women with obesity. To our knowledge, this has not been done in the literature.

Hence, using good quality data, including measured BMI and administrative data for health care use, the aim of our study was to provide new insights on this topic by exploring in details the clinical and healthcare related determinants of CCS nonadherence in the population with obesity. Guided by the conceptual framework of the Behavioral Model of Health Services Use developed by Andersen [17], we identified the predisposing, enabling and need factors for CCS nonadherence in

women with obesity, using structural equation modeling applied to data extracted from a French large population-based survey.

Materials and methods

Population

The CONSTANCES cohort is a population-based prospective cohort of a large sample of the population aged 18–69 years in France. Participants have been recruited since 2012 among people who are affiliated with the National Health Insurance Fund, which accounts for 85% of the French population, with a stratification on age, gender, socioeconomic status and region. At enrollment, participants completed self-administrated questionnaires providing information on personal, environmental, behavioral, occupational and social factors. Clinical and anthropometric data were also collected at inclusion during a medical examination. More details on the methods and quality control of the CONSTANCES cohort can be found elsewhere [18]. We used inclusion data over the period 2012-2015. In addition, exhaustive information on individual drug and medical claims had been extracted from the SNIIRAM database (the National Health Insurance database) and were available for the period 2009-2015 (*i.e.* three years before enrollment).

This study was focused on women aged 25 to 65 years with obesity (BMI ≥ 30 kg/m^2, based on measured height and weight at inclusion) (n=4,182). The linkage with the SNIIRAM data was achieved for 3,394 women (81%) (3% no consent for the linkage, 16% linkage failure). Women without linkage to the SNIIRAM data did not differ from the rest of the sample, except for a few characteristics: they were more frequently foreigner (7% vs 3%) and older (median: 53 vs 50). We excluded women who were not eligible to CCS according to the official guidelines [19] (hysterectomy (n=286), personal history of cervical or uterine cancer (n=13), no sexual intercourse

(n=130)). We also excluded HIV-infected women since they have specific recommendations for CCS due to their higher risk of cervical cancer (n=3) and pregnant women due to their biased measures of BMI and waist size (n=28). In all, 2,934 women with obesity were included in our study.

This analysis was approved by the relevant French ethics committees (authorization number 1825085).

Outcome

Women aged 25 to 65 years who did not have a Pap test during the past previous three years recorded in the SNIIRAM database were considered CCS-nonadherent [19].

Conceptual model

Our analysis is based on Andersen's behavioral model, which provides a conceptual framework for the predisposing, enabling, need and health behaviors determinants of health outcomes and allows accounting for the intertwined effects of these determinants with the health outcome (Fig. 1). Predisposing factors, which include demographic and social factors, incline an individual to use health services. Enabling factors, which regroup financial factors, are the resources that serve this use. Need factors reflect the necessity of care, and health behaviors that include health care use and personal health practices, predict this use. To investigate simultaneously the complex relationships between these four components and CCS nonadherence, we used structural equation modeling (SEM). This type of analysis enables one to take into account latent variables, which are constructed from observed variables [20] (so-called "indicators"). It also allows including

correlations when links between variables exist but are not causal. The following hypotheses were tested in our model (Fig. 1):

i. The predisposing characteristics affect the health outcome directly or indirectly through the enabling resources, the need factors and the health behaviors (a process known as mediation);

ii. The enabling resources influence the health outcome directly or indirectly through the need factors and the health behaviors;

iii. The need factors impact the health outcome directly or indirectly through the health behaviors;

iv. The health behaviors predict directly the health outcome.

Measures

The variables used in the analysis are presented in Table 1. The predisposing factors were age, being single, living without children, and the latent variable limited literacy, measured with foreign nationality, education and reporting difficulties with mathematical calculations, reading or administrative procedures. The enabling factors were assessed with the latent variable financial strain, measured with household income, financial difficulties, health insurance for low income and unmet healthcare needs due to financial problems. The need factors were assessed with three latent variables: obesity severity, comorbidities, and physical and mental health conditions. The latent variable obesity severity was measured with the degree of obesity (class I, class II and class III), the waist size and the hip circumference. The latent variable comorbidities was measured with the long-term illness fee exemption, the antidiabetic treatment, the

antihypertensive treatment, at least one endocrine disorder and personal history of cancer. The latent variable mental and health conditions was measured with depressive disorder, perceived health, difficulties climbing up or down stairs, walking or carrying a load alone and functional limitation due to a health-related problem. Regarding health behaviors, personal health practices were assessed with the regular participation in a sport, and healthcare use was assessed with the regularity of the follow-up by a gynecologist and the latent variable good-quality of primary care follow-up, measured with the number of general practitioner visits and the regularity of lipid or glucose testing.

Statistical analysis

SEM analysis was conducted to test our hypothesized model according a two-step process. First, a measurement model was assessed by confirmatory factor analysis, where relationships between each latent construct and its indicators were analyzed. Second, a structural model was employed to test the relationships between the latent constructs, other observed variables and CCS nonadherence. In the SEM model, only significant associations were kept (p-value <0.05), and were reported through arrows in figures. Since there were categorical variables, we used the weighted least squares with mean and variance adjustment estimator. The coefficients obtained for all the paths were standardized and ranged from r=-1 (perfect negative association) to r=+1 (perfect positive association).

Missing data were rare for all variables (<5%), except for the variables single (9%), living without children (7%), income (7%) and depressive disorder (6%) (more details in Table 1). The total percentage of missing data was 31%. Multiple imputations of

50 datasets were performed with the fully conditional specification method [21] on all variables in Table 1 and certain auxiliary variables.

The models' goodness-of-fit was confirmed by a standardized root mean square error of approximation (RMSEA) <0.05 and a comparative fit index (CFI) ≥0.90. All the statistical analyses were performed using SAS 9.4 and R 3.4.4, with the lavaan and semTools packages (versions 0.6-2.1264 and 0.5-0, respectively).

Results

Description of the population (Table 1)

In our sample, 14.0% of the women with obesity did not have a diploma. Three women in five ever experienced economic difficulties, 29.1% suffered from depressive disorder, 8.3% rated their health as poor to very poor, and 8.1% were morbidly obese. During the year of enrollment, 5.0% percent did not see a GP and 35.3% visited a GP more than six times. The proportion of women who had not had a lipid or glucose test in the previous three years was 19.6% and 16.4%, respectively. During the previous three years, 35.3% had not visited a gynecologist and 22.7% visited one at least once a year. Half of the women participated in a sport on a regular basis.

Approximately one-third of the women with obesity had not had a Pap test in the previous three years (31.6%). Significant higher CCS nonadherence rates were found among the following women: those who were older, single, foreign-born, living without children or in poor health, those with financial strain, those with a poor

gynecological follow-up, those with a poor primary care follow-up, and those who did not participate in a sport on a regular basis.

SEM model

All the factor loadings between each latent variable and its indicators were significant and ranged from 0.48 to 0.98 (Fig. 1). The measurement model indicated a CFI of 0.94 and an RMSEA of 0.046 (95% CI: 0.045-0.048), which suggests an acceptable fit. The SEM model is shown in Fig.2. The direct effect (direct arrow from the variable to the CCS nonadherence), indirect effect (product of the path coefficients conducting the variable to the CCS nonadherence through other variables) and total effect (sum of the direct and indirect effects) of all variables on CCS nonadherence are summarized in Table 2.

Direct effects on CCS nonadherence

Living without children was the only predisposing factor directly associated with CCS nonadherence, in a positive way (r=0.09). The enabling factor, *i.e.* the financial strain, had no direct effect on CCS. Among the need factors, obesity severity was directly positively associated with CCS nonadherence (r=0.13), while comorbidities and physical and mental health conditions had no direct effect on CCS nonadherence. Among the health behaviors, a regular follow-up by a gynecologist (r=-0.54) and a good quality of primary care follow-up (r=-0.13) were directly negatively related to CCS nonadherence.

Indirect effects on CCS nonadherence

Among the predisposing factors, age had an indirect positive influence on CCS nonadherence through the other factors (total indirect effect=0.09). Being single

had an indirect positive influence on CCS nonadherence through the path “single -> financial strain -> regular follow-up by a gynecologist -> CCS nonadherence” (total indirect effect=0.05). Limited literacy had an indirect positive influence on CCS nonadherence through the paths “limited literacy -> financial strain -> regular follow-up by a gynecologist -> CCS nonadherence” and “limited literacy -> regular follow-up by a gynecologist -> CCS nonadherence” (total indirect effect=0.11). The indirect effect of living without children was weak (total indirect effect=-0.02). Among the enabling factors, financial strain had a positive indirect influence on CCS nonadherence, most of this association being mediated by a regular follow-up by a gynecologist (total indirect effect=0.09). Among the need factors, comorbidities had a negative effect on CCS nonadherence, which was mediated by a good quality of primary care follow-up (total indirect effect=-0.08).

Residual correlation

A positive correlation was found between a regular follow-up by a gynecologist and the following three variables: good quality of primary care follow-up, comorbidities and regular participation in a sport.

Discussion

To our knowledge, this study is the first to provide a conceptual framework for CCS nonadherence in women with obesity. We found that women with obesity encounter the same obstacles to CCS as women in the general population [22]. These include limited literacy, financial strain and a poor healthcare providers' follow-up. In addition, our study clarified the role of healthcare providers' follow-up and of different health characteristics (obesity severity, comorbidities and limitations) in CCS nonadherence in women with obesity.

Previous studies found that low education level, limited health literacy are associated with CCS nonadherence [23-25]. Women with limited literacy skills and a low education level might have a lower capacity to understand the importance of CCS for prevention and for an early detection of cancer. Even if we did not directly measure health literacy, we did study its basic and functional part [26]. Consistent with the literature, we found limited literacy to have an impact in terms of CCS nonadherence. However, in our study, limited literacy only had an indirect effect on CCS nonadherence, which was mediated by financial strain and regular follow-up by a gynecologist. For the part of this association not explained by financial strain, we can suppose that women with obesity and limited literacy may avoid a regular follow-up by a gynecologist in part due to a strong distrust of the healthcare system, possibly because they more often fail to overcome the weight-related obstacles, such as embarrassment and weight stigma [27, 28].

Unlike the regular follow-up by a gynecologist, limited literacy had a positive impact on primary care follow-up, which may reflect the more frequent use of GP by low educated women. We found that the link between limited literacy and

primary care follow-up was fully mediated by the presence of comorbidities and not explained by financial strain. This contrasts with the available studies conducted in the general population [29, 30].

In the literature, financial strain is strongly associated with nonparticipation in CCS [31], but the studies do not identify the mechanisms of action. Our analysis shows that financial strain indirectly contributes to CCS nonadherence, as it entails a low likelihood of a regular follow-up by a gynecologist. In addition to barriers such as distance and availability of health professionals, time needed for the medical visit, competition between needs (food, childcare) and indirect costs (transportation costs or lost income), this association is likely to be largely due to the cost of the visit to a gynecologist (about 85% of gynecologists charge out-of-pocket fees) that is only partly covered by private supplementary health insurance. In France, only four percent of the population does not have a private supplementary health insurance, but large disparities exist between the different types of private supplementary health insurances.

Interestingly, the obesity severity was positively associate with CCS nonadherence but did not influence the regularity of the follow-up by a gynecologist. This means that, although women with severe obesity are as likely as other women to visit a gynecologist, they are more likely not to be screened. This can be explained by two hypotheses. Women with severe obesity might have greater weight-related obstacles to CCS than other women and might consequently turn down this test, which involves getting undressed and lying down on an examination table in an embarrassing position. This hypothesis is supported by the study of Mitchell *et al.* [32] who found that women with severe obesity were over two times more likely

than women with normal weight to cite ‘fear’ (*e.g.* painful, embarrassing and find something wrong) as an obstacle to CCS while no differences were observed between other weight groups. As well, there may be unwillingness from the practitioner possibly due to a lack of proper equipment to perform the test, a lack of knowledge or time, a discomfort regarding the gynecological examination in women with severe obesity or even discriminatory medical practices [33, 34].

According to the literature, people with chronic diseases and/or who are obese visit a general practitioner more often that the rest of the population [13, 14]. In the general population, consulting a general practitioner is also associated with better screening behaviors [15, 16]. The situation is more complex in women with obesity because of possible competitive care. The literature does not provide a clear answer because some studies have found that the presence of comorbidities is associated with less good screening behaviors, while others have found no link or have found, on the contrary, that instead of being an obstacle, it acts as a springboard [12, 35]. Our results suggest that there is no competitive care and show the importance of primary care in accessing preventive care. Indeed, the presence of comorbidities is indirectly associated with better screening practices, the effect being fully mediated by the primary care follow-up. It should be noted that, our latent variable measuring the primary care follow-up combines two dimensions. First, it shows the general practitioner’s intention to monitor the patient for comorbidities associated with his or her patient’s obesity, should any occur, or to monitor their course with laboratory tests, if the patient already has such comorbidities. It also indicates the interest that women with obesity show in their health by way of visiting regularly their general practitioner and to undergoing the prescribed blood tests.

To characterize the health of women with obesity, apart from the obesity severity and the presence of diagnosed comorbidities, we considered physical and mental limitations. Our analyses, conducted on a population-based sample, do not show an association between this dimension and CCS nonadherence or with primary care follow-up or a regular follow-up by a gynecologist. These results could be explained by the fact that the confounding factors involved in these relationships were taken into account, such as obesity severity, the presence of comorbidities, financial strain and literacy. Our results highlight the importance of distinguishing the different aspects of health to better understand the mechanisms of the women with obesity participation in screening.

Studies have shown that women who engage in a physical activity have higher rates of CCS [36, 37]. Our results are consistent with this finding as we found that the two dimensions of health behaviors, namely regular participation in a sport and frequent healthcare use, were positively correlated, and overall better health behaviors were associated with better screening practices. A regular participation in a sport could reflect the woman's desire to take care of her health. Indeed, we found that for the same physical and mental health conditions, the presence of comorbidities was correlated with regular participation in a sport, which is likely to be done in order to control the comorbidities and improve health. On the other hand, regular participation in a sport implies for women with obesity to be self-confident and more outgoing, personality traits that surely help them to overcome the weight barriers and weight stigma in medical care. This hypothesis is supported by the qualitative study of Friedman *et al*. [6], who found that all the women with obesity faced the same obstacles to screening, but that the women with good screening behaviors shared certain personality traits, such as self-discipline and

self-motivation. Other studies are needed to supplement our results and better understand the influence of personality traits on participation in cervical cancer screening in women with obesity.

The major strengths of our study include the size of our population and the large number of high-quality variables, especially measured BMI and administrative data for CCS nonadherence and healthcare use. Consequently, this limits reporting, recall and social desirability bias. However, the other variables from the self-questionnaires do suffer from such biases. The high proportion of women reporting regular participation in a sport may be due to the broad definition used for sport. Nevertheless, the percentage of women reporting regular participation in a sport in the whole CONSTANCES population is close to the one found in a French survey using a similar broad definition (64.5% and 63% respectively) [38]. In addition, the CONSTANCES sample suffers from an overrepresentation of women with a high socioeconomic position. The percentage of women with obesity in our study, 12%, was lower than that found in the French population (15.6%). Consequently, our results may be biased, since the most underprivileged women were not included.

Our study is also limited in that the temporality dimension is missing, due to its cross-sectional design. However, many of the variables probably did not change significantly over the 3 years preceding study inclusion, the period examined in terms of CCS uptake and healthcare use. It is highly likely that, at study inclusion, the women with obesity were already suffering from obesity or at least severely overweight 3 years earlier, as obesity is a gradually developing condition. Finally, we could not exclude women who received post-treatment Pap test. However, given the small number of women potentially in this situation, this is not likely to

substantially bias our results. Indeed, we identified 131 (4.5%) women with obesity who have had at least two Pap tests in an interval between two and eight months. Only 56 (2%) would have been CCS nonadherent if we had not taken into account this second Pap smear and all the successive tests.

Our results highlight the complex relationships between the predisposing, enabling, need factors, health behaviors and CCS nonadherence, and identify a number of important factors in understanding CCS uptake among women with obesity. Beyond the specific weight-related barriers, we found that women with obesity face the same barriers to CCS as women in the general population (financial strain, limited literacy, irregular visits to healthcare providers). More efforts are needed to increase CCS participation among all women, especially through a higher involvement of general practitioners in promoting preventive services and with measures focused on women with low socioeconomic status. Lastly, providing CCS in women with obesity necessitates special care both on the psychological aspects (reducing reluctance or even refusal to get a gynecological exam) and the technical aspects. Indeed, a recent study found that in screened women, increasing BMI was associated with a lower rate of detection of cervical precancer and a higher risk of cervical cancer, which suggests inadequate Pap testing in women with obesity [39].

Authorship contribution

GM and JF designed the study. JF ran the analyses and wrote the paper. JF and MP prepared the dataset. All authors discussed the results and their interpretation, participated to the writing of the paper and approved the final version of the manuscript.

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Compliance with ethical standards

Competing Interests

The authors do not have competing interests to declare.

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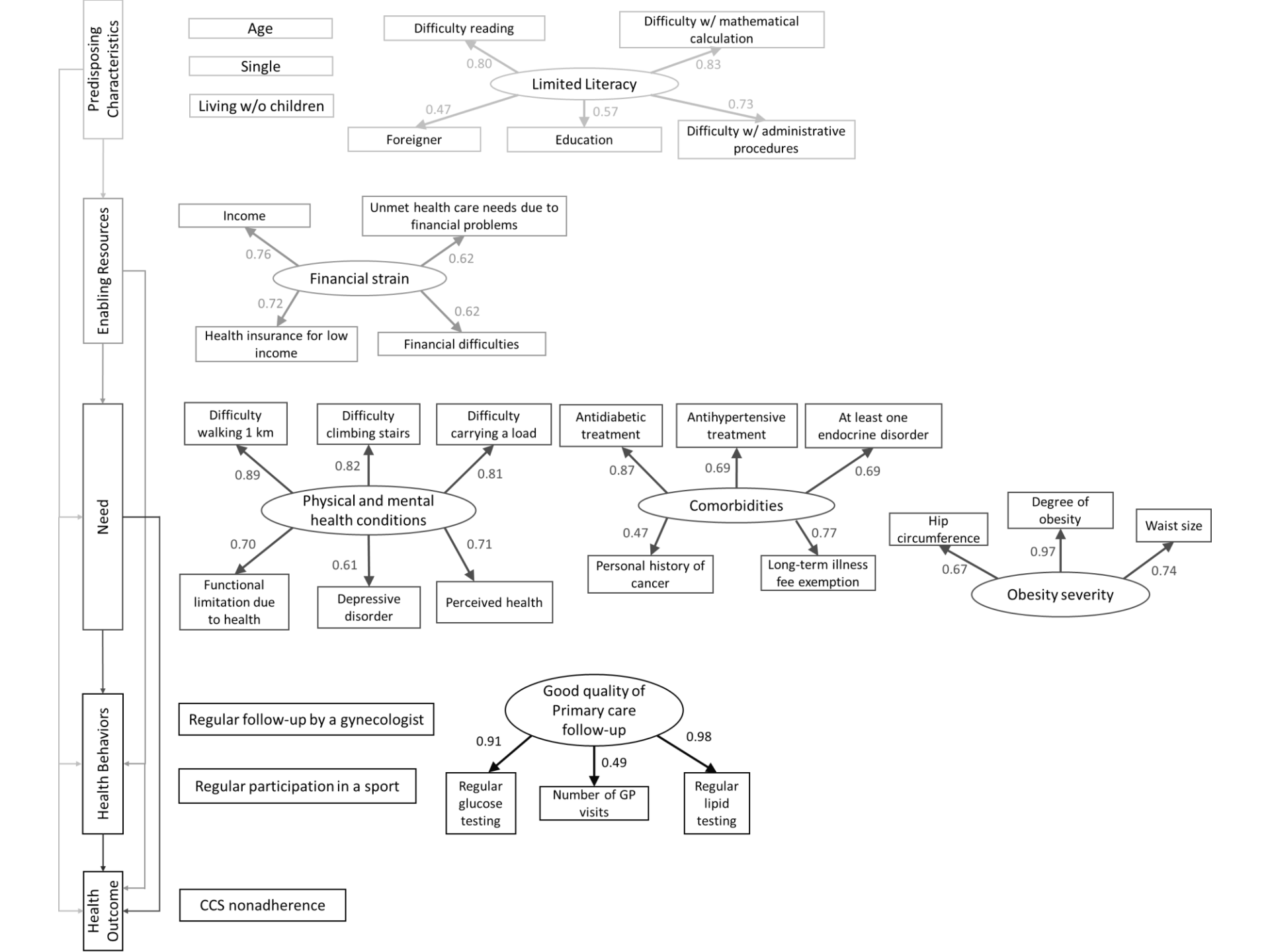
Predisposing Characteristics
Enabling Resources
Need
Health Behaviors
Health Outcome
Age
Single
Living w/o children
Difficulty reading
Difficulty w/ mathematical calculation
0.80
0.83
Limited Literacy
0.47
0.57
0.73
Foreigner
Education
Difficulty w/ administrative procedures
Income
Unmet health care needs due to financial problems
0.76
0.62
Financial strain
0.72
0.62
Health insurance for low income
Financial difficulties
Difficulty walking 1 km
Difficulty climbing stairs
Difficulty carrying a load
0.89
0.82
0.81
Physical and mental health conditions
0.70
0.61
0.71
Functional limitation due to health
Depressive disorder
Perceived health
Antidiabetic treatment
Antihypertensive treatment
At least one endocrine disorder
0.87
0.69
0.69
Comorbidities
0.47
0.77
Personal history of cancer
Long-term illness fee exemption
Hip circumference
Degree of obesity
Waist size
0.67
0.97
0.74
Obesity severity
Regular follow-up by a gynecologist
Regular participation in a sport
Good quality of Primary care follow-up
0.91
0.49
0.98
Regular glucose testing
Number of GP visits
Regular lipid testing
CCS nonadherence

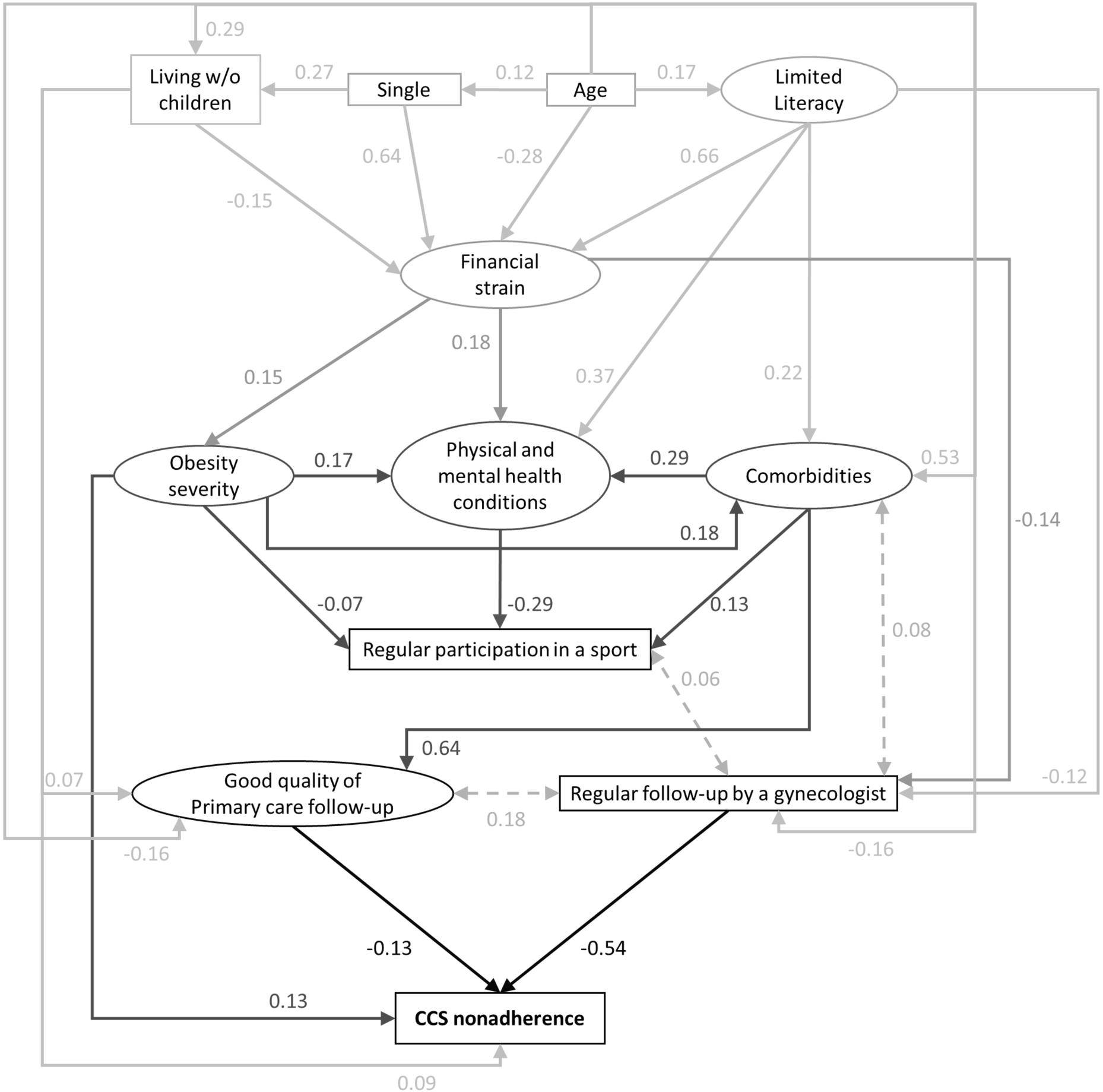
0.29
Living w/o children
0.27
Single
0.12
Age
0.17
Limited Literacy
0.64
-0.28
0.66
-0.15
Financial strain
0.18
0.15
0.37
0.22
Obesity severity
0.17
Physical and mental health conditions
0.29
Comorbidities
0.53
-0.14
0.18
-0.07
-0.29
0.13
Regular participation in a sport
0.08
0.06
0.64
0.07
Good quality of Primary care follow-up
0.18
Regular follow-up by a gynecologist
-0.12
-0.16
-0.16
-0.13
-0.54
0.13
CCS nonadherence
0.09

Table 1. Characteristics of the women with obesity enrolled in the CONSTANCES survey who were eligible for CCS (n=2,934): distribution and associated crude CCS nonadherence rates.

		Median (IQR) or %	Nonadherence rate %	Missing values§ %	*P*-value¥
PREDISPOSING CHARACTERISTICS					
	Age	49 (40-57)		0.0	**<0.001**
	Single			9.0	**<0.001**
	No	76.9	29.6		
	Yes	23.1	38.2		
	Living without children			7.4	**<0.001**
	No	57.6	28.3		
	Yes	42.4	36.0		
Limited Literacy¶	**Foreigner**			1.1	**0.014**
	No	96.7	31.2		
	Yes	3.3	43.1		
	Difficulty with mathematical calculations			3.1	**0.006**
	No	93.4	31.0		
	Yes	6.6	40.6		
	Difficulty reading			1.9	**<0.001**
	No	91.9	30.7		
	Yes	8.1	41.6		
	Difficulty with administrative procedures			1.0	**<0.001**
	No	90.0	30.2		
	Yes	10.0	44.2		
	Education			1.7	**<0.001**
	No diploma or Primary education	14.0	43.3		
	Vocational secondary	22.3	32.4		

	High school	19.7	28.0		
	High school + 2 to 4 years	33.5	28.7		
	High school + 5 or more years	10.5	30.1		
ENABLING RESOURCES					
Financial strain¶	**Total net monthly household income (€)**			7.0	**<0.001**
	<1000	7.2	43.4		
	[1000-1500[	11.8	37.6		
	[1500-2100[	14.8	36.5		
	[2100-2800[	22.0	31.4		
	[2800-4200[	28.4	27.7		
	≥4200	15.7	24.4		
	Financial difficulties[a]			2.2	**0.001**
	Never	41.6	28.3		
	In the past	31.7	32.0		
	Currently	26.7	36.2		
	Health insurance for low income*			0.0	0.09
	No	96.0	31.3		
	Yes	4.0	38.8		
	Unmet health care needs due to financial problems			2.2	**<0.001**
	No	72.7	29.2		
	Yes	27.3	38.0		
NEED					
Physical and mental	**Depressive disorder**			6.4	0.45
	No	70.9	31.2		
	Yes	29.1	32.6		
	Perceived health			5.1	**0.006**
	Good to very good	58.1	30.0		
	Fair	33.5	32.2		
	Poor to very poor	8.3	40.4		
	Difficulty climbing up or down stairs alone			1.6	0.07
	No	80.5	30.6		
	Some	16.4	35.6		
	Unable or significant difficulty	3.2	36.0		

tal health conditions¶	**Difficulty walking one kilometer alone**			1.3	**<0.001**
	No	82.0	30.1		
	Some	13.8	36.3		
	Unable or significant difficulty	4.1	44.7		
	Difficulty carrying a load weighing 5 kg over a distance of 10 m alone			1.2	**0.026**
	No	78.2	30.6		
	Some	15.8	33.0		
	Unable or significant difficulty	6.0	40.2		
	Functional limitation due to a health-related problem[b]			1.2	0.61
	Limited	27.3	33.0		
	Slightly limited	28.3	31.0		
	No	44.4	31.1		
Comorbidities¶	**Long-term illness fee exemption[c,*]**			0.0	0.28
	No	83.8	31.2		
	Yes	16.2	33.7		
	Antidiabetic treatment within the last 12 months*			0.0	0.38
	No	95.8	31.4		
	Yes	4.2	35.2		
	Antihypertensive treatment within the last 12 months*			0.0	0.12
	No	81.8	31.0		
	Yes	18.2	34.5		
	At least one endocrine disorder[d]			0.0	0.81
	No	89.3	31.7		
	Yes	10.7	31.0		
	Personal history of cancer			0.0	0.95
	No	94.8	31.6		
	Yes	5.2	31.8		
Obesity s	**Degree of obesity (BMI, kg/m^2)**			0.0	**<0.001**
	Class I (30-34.9)	68.5	28.6		
	Class II (35-39.9)	23.4	35.1		
	Class III (≥ 40)	8.1	46.4		

severity¶	**Waist size (cm)**	99 (93-106)		0.0	**<0.001**
	Hip circumference (cm)	115 (110-121)		0.0	**<0.001**
HEALTH BEHAVIORS					
Good quality of Primary care follow-up¶	**Number of general practitioner visits during the year of enrollment***			0.0	**<0.001**
	None	5.4	45.2		
	1-3	30.6	36.4		
	4-6	28.7	28.9		
	>6	35.3	27.6		
	Regular lipid testing over the past three years[e,]*			0.0	**<0.001**
	None	19.6	44.1		
	Irregular	32.7	29.3		
	Moderate	28.1	31.2		
	Regular	19.7	23.4		
	Regular glucose testing over the past three years[e,]*			0.0	**<0.001**
	None	16.4	46.0		
	Irregular	31.6	30.9		
	Moderate	30.6	30.0		
	Regular	21.4	23.8		
	Regular follow-up by a gynecologist over the past three years[e,]*			0.0	**<0.001**
	None	35.3	66.7		
	Irregular	21.9	19.7		
	Moderate	20.0	11.4		
	Regular	22.7	6.3		
	Regular participation in a sport[f]			1.4	**<0.001**
	No	51.2	34.7		
	Yes	48.8	28.4		

Abbreviations: CCS: cervical cancer screening; IQR: interquartile range.
§ Before multiple imputations.
ɣ Statistical comparison according CCS nonadherence with x2 and Kruskal-Wallis tests as appropriate. Significant p-values are indicated in bold.

¶ Name of the latent variable.
* Data from the SNIIRAM (French Health Insurance database).
a Difficulties meeting financial needs.
b Being limited in performing routine activities that people of the same age can normally perform.
c Corresponding to the full reimbursement of medical fees for a specific condition.
d Including treated hypercholesterolemia and treated hypertriglyceridemia.
e Regular= test(s)/visit(s) each of the three years; Moderate= test(s)/visit(s) during two of the three years; Irregular= test(s)/visit(s) during one of the three years; None= no test/visit during the three years.
f Regular participation in a sport was defined as doing regularly sport during the last past 12 months (except DIY, gardening, housework, trip on foot or by bike).

Table 2. Direct, indirect and total effects on CCS nonadherence among women with obesity according to the statistical model.

	Effects on CCS nonadherence		
	Direct	**Indirect**	**Total**
PREDISPOSING CHARACTERISTICS			
Age		0.09	0.09
Single		0.05	0.05
Living without children	0.09	-0.02	0.07
Limited Literacy		0.11	0.11
ENABLING RESOURCES			
Financial strain		0.09	0.09
NEED			
Comorbidities		-0.08	-0.08
Obesity severity	0.13	-0.01	0.12
HEALTH BEHAVIORS			
Good-quality of Primary care follow-up	-0.13		-0.13
Regular follow-up by a gynecologist	-0.54		-0.54

Abbreviations: CCS: cervical cancer screening.
The values represent standardized coefficients. All coefficients have p-values <0.05.