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Socio-Economic Inequalities in Beliefs About Cancer and its Causes: Evidence From two Population Surveys

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ABSTRACT

Objective: People's beliefs about cancer can affect the actions they take to prevent and detect the disease. We investigated socio-economic inequalities in beliefs about cancer and its causes in the general population.

Methods: We analyzed data from the representative probabilistic Spanish Oncobarometer survey ($N = 4769$, 2020) and the non-probabilistic weight-corrected Spanish Cancer Awareness Survey ($N = 1029$, 2022). Beliefs about cancer, recognition of cancer symptoms, and recognition of risk factors were measured with the Awareness and Beliefs about Cancer questionnaire. Endorsement of mythical causes was measured with the CAM-Mythical Causes questionnaire. The effects of socio-economic status (SES) were investigated in multiple regression analyses adjusted for age, sex, and personal and family cancer history.

Results: Individuals with lower SES were more likely to endorse pessimistic beliefs (e.g., "cancer is a death sentence"), and less likely to endorse optimistic beliefs about cancer (e.g., "people with cancer continue with normal activities"). Individuals with lower SES also recognized fewer cancer symptoms and risk factors and endorsed more mythical causes of cancer. The gap in knowledge regarding cancer causes was wider among people with low SES, who were more likely to endorse several mythical causes than some established risk factors included in cancer prevention recommendations.

Conclusions: Socio-economic inequalities in beliefs about cancer are robust and multidimensional and indicate worse preparedness to act against the disease among lower socio-economic groups. Differences in beliefs about disease outcomes and

causes are likely one of the multiple contributors to cancer disparities and should be targeted and monitored in prevention efforts.

1 | Background

Cancer is one of the leading causes of morbidity and mortality worldwide [1]. It poses a large social burden on patients and their families and an increasing economic strain on countries [2]. The burden of cancer can be reduced through prevention and early detection efforts. For instance, following cancer prevention recommendations such as avoiding tobacco and alcohol, maintaining healthy body weight, eating a healthy diet, and being physically active, among others, can prevent up to 40% of cancer cases [3]. Participating in organized screening programs can help detect precancerous lesions, whereas seeking help soon after symptom onset can help diagnose the disease at an earlier stage. However, awareness of and adherence to cancer prevention recommendations in the population remains low [4]. This is why in Europe, one of the European Union's (EU) Beating Cancer Plan objectives is to improve health literacy on cancer risks and determinants [4].

Another aim of the EU Beating Cancer Plan is the reduction of cancer inequalities. Research shows that people with lower socio-economic status (SES), indexed by education, income, or occupation, are more likely to develop certain types of cancer [5] and have lower cancer survival [6]. These disparities have been attributed to diverse factors including more exposure to carcinogens and unhealthy lifestyles and less access to early diagnosis and treatment among lower socio-economic groups [5, 6].

Differences in awareness and beliefs about cancer could also be contributing to the observed socio-economic inequalities because they can affect the actions people take to prevent and detect cancer [7]. For instance, previous studies have shown that people with lower SES are less knowledgeable of cancer symptoms [8–10] and more likely to have pessimistic or fatalistic beliefs about cancer (e.g., that cancer is a death sentence) [9, 11, 12]. Such negative beliefs have been associated with delayed help-seeking [7, 13] and less participation in population-based cancer screening programs [14].

Studies have also shown that people with lower SES recognize fewer risk factors for cancer [15–18], as do men and older individuals [18, 19]. However, the effect of SES is not uniform in direction and size for all cancer risk factors [19, 20]. Another related aspect of cancer awareness that has been much less explored is the extent to which people believe in mythical causes of cancer [21, 22]. These refer to factors that have not been established as cancer causes and are not part of cancer prevention recommendations (e.g., use of mobile phones, microwave ovens or genetically modified foods, to name a few). Such erroneous beliefs can interfere with effective cancer prevention by misplacing efforts to reduce cancer risk. The few studies that investigated beliefs in mythical causes of cancer in relation to SES found mixed results [22–24].

Overall, previous studies suggest that there is a socio-economic gradient to cancer awareness and beliefs that may be universal across many cultures and health systems [9, 25, 26]. However, few previous studies report on socio-economic inequalities in cancer awareness in countries from Southern Europe [19, 27]. The effects of SES on endorsement of mythical causes of cancer have also been rarely explored [21–24]. To fill these gaps, the main aim of this research was to investigate the effect of SES on positive and negative beliefs about cancer, recognition of symptoms, recognition of risk factors, and beliefs in mythical causes of cancer in the general population in Spain. Secondary aims included investigating the effects of other personal characteristics such as sex, age, and cancer history.

2 | Methods

We used data from two population surveys of adults ≥ 18 years old residing in Spain, each of which provided different dependent measures of interest. In particular, the relationship between SES and positive and negative beliefs about cancer was investigated in the 2020 Spanish Oncobarometer, whereas the relationship between SES and recognition of symptoms, recognition of risk factors, and beliefs in mythical causes of cancer was investigated in the 2022 Spanish Cancer Awareness Survey (S-CAS).

2.1 | The 2020 Spanish Oncobarometer

In 2020, the Spanish Association against Cancer conducted the Oncobarometer, a probabilistic national cross-sectional survey about public perceptions of cancer in Spain [27, 28]. Data collection was outsourced to a specialized research market company (Demometrica). Telephone computer-assisted interviews were conducted by trained interviewers in two waves due to an interruption related to the Covid-19 pandemic (in February/March and then in August/September). Eligible participants included Spanish-speaking individuals aged 18 or above.

A two-stage sampling approach was used: first, a stratified random sample of households was chosen in proportion to the population sizes of the Spanish Autonomous Regions. Subsequently, sampling units were selected based on sex and age quotas, with one interview conducted per household. In cases of unit nonresponse, replacement sampling units were selected adhering to sex and age quotas until fulfillment.

2.2 | The 2022 Spanish Cancer Awareness Survey (S-CAS)

In 2022, the Spanish Cancer Awareness Survey was conducted in a collaboration between the Andalusian School of Public

Health and the University of Granada. The survey was distributed online using the LimeSurvey software. A non-probability sampling approach was used, and the survey was strategically disseminated by both institutions across diverse social networks and email platforms targeting people from the general population. Inclusion criteria were being at least 18 years old and residing in Spain. The data collection spanned from November 2021 to January 2022.

2.3 | Personal Characteristics

Socio-demographic information collected in both surveys included sex (male vs. female), age (categorized into six groups: 18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, and 65 years and above), and civil status (married or cohabitating, single, separated/divorced, widowed, and others). Participants indicated if they had previous personal history of cancer (i.e., if a health professional ever told them they had cancer: yes vs. no) and if they ever had a close family member (e.g., first or second degree relative) diagnosed with cancer (yes vs. no).

2.4 | Socio-Economic Status (SES)

In the Oncobarometer, SES was based on questions about occupation and education and was classified into "high", "medium", and "low" following criteria developed by the Spanish Society of Epidemiology [29]. The "high" SES group included directors and managers, professionals traditionally associated with university degrees, and other technical support professionals, including sportsmen and artists. The "middle" group included intermediate occupations, self-employed workers, and supervisors and workers in qualified technical occupations. Finally, the "low" group included qualified workers from the primary sector, other semi-skilled workers, and unskilled workers.

In the S-CAS, SES was determined based on education level again following the Spanish Society of Epidemiology [29]. Participants indicated their highest level of completed education into one of 10 available categories, which were categorized as "high" (university-level education), "medium" (higher professional-level education), and "low" (primary or secondary education).

2.5 | Questionnaires About Cancer

These were based on the Awareness and Beliefs about Cancer (ABC) questionnaire [27, 30] by the International Cancer Benchmarking Partnership (ICBP) and the Cancer Awareness Measure-Mythical Causes Scale (CAM-MYCS) [21]. The questionnaires had been previously adapted for use in the Spanish-speaking population in a pilot study described elsewhere [28].

2.5.1 | Positive and Negative Beliefs About Cancer

In the Oncobarometer, participants responded to the module on beliefs about cancer of the Awareness and Beliefs about Cancer (ABC) questionnaire [27, 30]. The answers to each of six statements (three positive and three negative) included in Supporting Information S1: Table S1 were recorded on a scale including "strongly agree", "agree", "disagree", "strongly disagree", or "I don't know".

2.5.2 | Recognition of Cancer Symptoms

In the S-CAS, participants were asked whether each of 13 cancer symptoms could be a warning sign for cancer, with response options "Yes", "No," and "I don't know". We calculated the number of correctly recognized symptoms (i.e., "Yes" responses) for each respondent [30, 31]. The list of symptoms also included 2 non-cancer symptoms as filler items (skin rash and stuffy nose).

2.5.3 | Recognition of Risk Factors

In the S-CAS, participants were asked for each of 13 risk factors for cancer whether they thought it increased the risk of having cancer, with response options "Yes", "No," and "I don't know". We calculated the number of correctly recognized risk factors (i.e., "Yes" responses) for each respondent [30, 31].

2.5.4 | Endorsement of Mythical Causes

In the S-CAS, participants were asked for each of 12 items included in the CAM-MYCS scale [21] whether they thought it increased the risk of having cancer, with response options "Yes", "No," and "I don't know". We calculated the number of endorsed mythical causes (i.e., "Yes" responses) for each respondent.

2.6 | Statistical Analysis

For the Oncobarometer, sampling weights provided by the recruiting company were applied in all analyses. In the case of S-CAS, to adjust for the lack of probability sampling and the resulting non-representativeness, the sample was weighted using a combination of methods (propensity score adjustment and calibration) that have shown to reduce bias [32, 33][1].

The belief items administered in the Oncobarometer had low internal consistency, advising against the calculation of an overall beliefs score, and were hence analyzed individually. Following previous research [34–36], responses to each belief item were dichotomized as "agree" if the person indicated "strongly agree" or "agree" and as "disagree/does not know" if the person indicated "strongly disagree", "disagree" or did not know. Refusals to answer were treated as missing. We conducted 6 multiple logistic regression models (one for each belief item). The dependent variable was the dichotomized response to each belief item and the independent variables were SES, sex, age group, personal and family history of cancer, and Oncobarometer survey wave.

For the remaining outcomes measured in the S-CAS, we conducted three multiple linear regression models. The dependent variables were the scores for recognition of symptoms, recognition of risk factors, and endorsement of mythical causes, respectively, and the independent variables were SES, sex, age group, and personal and family history of cancer.

Analyses were conducted in SPSS v28. All models were estimated using the GENLIN module based on maximum likelihood estimation and using the robust (Huber-White) estimator.

3 | Results

The response rate for the Oncobarometer survey was 64.1%. In the case of the S-CAS, 1235 participants started the survey and 1029 completed it, resulting in 83% completion rate. The demographic characteristics of participants in both surveys are described in Table 1. In both surveys, the low SES category was the most represented (with 36.5% and 45.1% in the Oncobarometer and S-CAS, respectively).

The percentage of respondents endorsing each belief item in the Oncobarometer is reported in Supporting Information S1: Table S1 and the percentages of respondents recognizing each symptom, risk factor, and mythical cause in the S-CAS are displayed in Supporting Information S1: Figures S1–S3, respectively.

3.1 | Positive Beliefs About Cancer

People with lower SES were less likely to agree that people with cancer can continue with their normal activities (OR = 0.63, 95% CI [0.53, 0.96] for low vs. high SES and OR = 0.80, 95% CI [0.67, 0.95] for medium vs. high SES) (see Figure 1 and Supporting Information S1: Table S2). They were also less likely to agree that cancer can often be cured (OR = 0.69, 95% CI [0.58, 0.83] for low vs. high SES). There was no effect of SES on the third positive belief item about quick help-seeking.

TABLE 1 | Sample characteristics of the 2020 Spanish Oncobarometer survey ($N = 4769$) and the 2022 Spanish awareness survey (S-CAS, $N = 1029$).

		2020 Spanish Oncobarometer survey		2022 Spanish cancer awareness survey (S-CAS)	
Variable	**Category**	**N**	**Percent**	**N**	**Percent**
Sex	Male	2072	43.5	499	48.5
	Female	2697	56.5	530	51.5
Age	18–24 years	394	8.3	88	8.5
	25–34 years	655	13.7	139	13.5
	35–44 years	913	19.2	186	18.1
	45–54 years	918	19.2	201	19.5
	55–64 years	751	15.7	169	16.5
	65 + years	1138	23.9	247	24.0
Civil status	Married or cohabiting	2433	51.0	663	64.4
	Single	1577	33.1	238	23.1
	Separated/divorced	394	8.3	78	7.6
	Widowed	344	7.2	29	2.8
	Other	21	0.4	21	2.0
Socio-economic position[a]	High level	1272	26.7	393	38.2
	Medium level	1312	27.5	172	16.7
	Low level	1738	36.4	464	45.1
	Missing	447	9.4	0	0.0
Personal history of cancer	Yes	440	9.2	113	11.0
	No	4322	90.6	916	89.0
	Missing	7	0.1	0	0.0
Family history of cancer	Yes	3533	74.1	878	85.3
	No	1226	25.7	151	14.7
	Missing	10	0.2	0	0.0

Note: A "Missing" category is indicated for all variables with missing data.
[a]In the Oncobarometer, SES was based on questions about occupation and education following criteria developed by the Spanish Society of Epidemiology [29]. In the S-CAS, SES was determined based on education level again following the Spanish Society of Epidemiology [29].

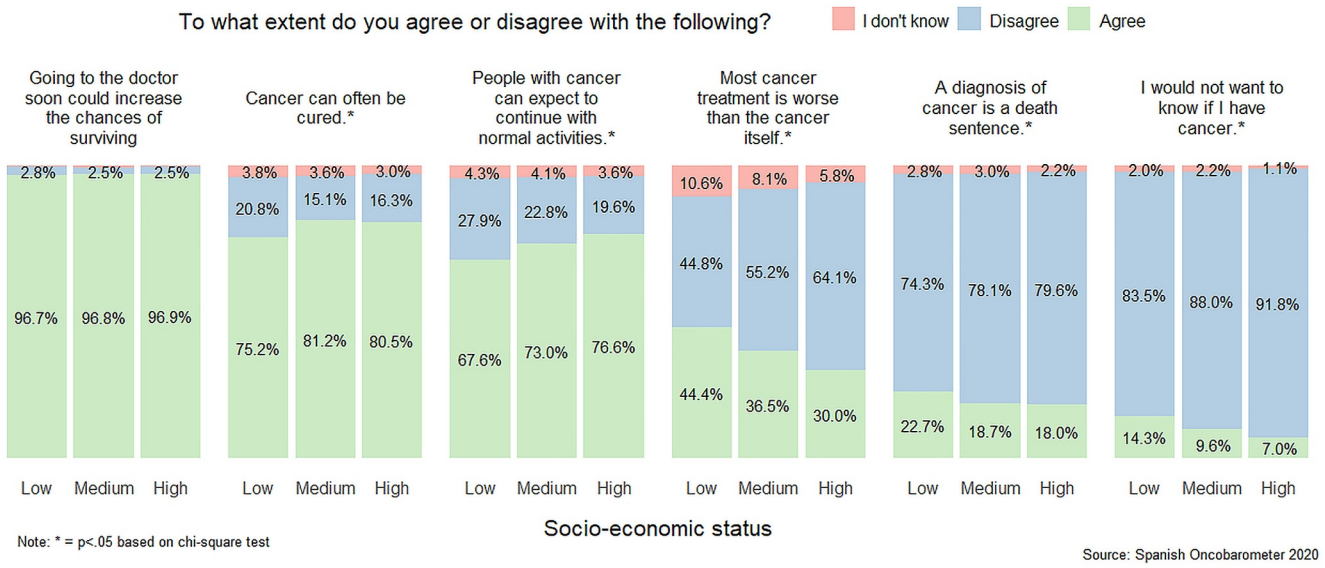

FIGURE 1 | Beliefs about cancer as a function of socio-economic status in the 2020 Spanish Oncobarometer survey ($N = 4769$).

Regarding the other personal characteristics, women were less likely to endorse two of the three positive cancer beliefs and older individuals and those with personal history of cancer were more likely to believe that cancer can often be cured (Supporting Information S1: Table S2).

3.2 | Negative Beliefs About Cancer

People with lower SES were more likely to agree with all three negative beliefs about cancer, with odds ratios (OR) for low versus high SES of OR = 1.86, 95% CI [1.59, 2.17], OR = 2.15, 95% CI [1.66, 2.75], and OR = 1.38, 95% CI [1.15, 1.66] for the cancer treatment, not wanting to know, and death sentence items, respectively (see Supporting Information S1: Table S3 and Figure 1).

Regarding the other personal characteristics, women were more likely to endorse two of the three negative beliefs (Supporting Information S1: Table S3). Middle-aged adults (35–54 yo) were less likely to believe that treatment is worse than the cancer itself than the youngest group (18–24 yo), whereas the oldest individuals (55+ yo) were more likely not to want to know that they have cancer compared to the youngest group (18–24 yo). People with personal history of cancer were more likely to endorse the treatment item but less likely to endorse the other two negative beliefs.

3.3 | Recognition of Cancer Symptoms

People with low SES recognized on average 3 symptoms fewer ($B = -3.22$, SE = 0.28, $p < 0.001$) than people with high SES (4.3 (SE = 0.2) versus 7.6 (SE = 0.3) symptoms recognized, respectively) (see Figure 2 and Supporting Information S1: Table S4). People with middle SES also recognized fewer symptoms than those with high SES ($B = -1.67$, SE = 0.34, $p < 0.001$).

All personal factors had significant effects on the number of recognized symptoms, with women, younger individuals, and persons with personal and family history of cancer recognizing more symptoms. The effect of age was particularly strong, such that the oldest group (65+) had a markedly lower recognition ($M = 4.2$ symptoms, SE = 0.3) compared to the remaining age groups (recognizing between 5.9 and 8.7 symptoms on average).

Given the very consistent effect of SES on virtually all symptoms, to address the possibility that results may be due to a general tendency to respond "yes" among people with high SES, we analyzed responses to the two filler items "stuffy nose" and "skin rash" (see Supporting Information S1: Figure S4). People with high SES were less likely to think that these symptoms could be signs of cancer compared to people with low SES, speaking against an underlying response tendency.

3.4 | Recognition of Risk Factors

People with low SES recognized on average 1 risk factor fewer ($B = -1.35$, SE = 0.24, $p < 0.001$) than people with high SES (8.0 (SE = 0.2) versus 9.4 (SE = 0.2) risk factors recognized, respectively) (see Figure 3 and Supporting Information S1: Table S4). People with medium SES also recognized fewer risk factors than those with high SES ($B = -1.67$, SE = 0.28, $p < 0.001$). SES differences were significant for all factors with the exception of obesity and sunbed use and were more pronounced for the least recognized risk factors overall (e.g., age, low physical activity, alcohol consumption, and HPV infection). Notably, several risk factors, including obesity, red and processed meat consumption, HPV infection, and low fruit and vegetable consumption, showed a U-shaped pattern, such that recognition was lowest among the medium SES group.

In addition, the oldest group (65+) recognized fewer risk factors compared to the youngest group (18–24 yo) and people with personal or family history of cancer recognized more risk factors.

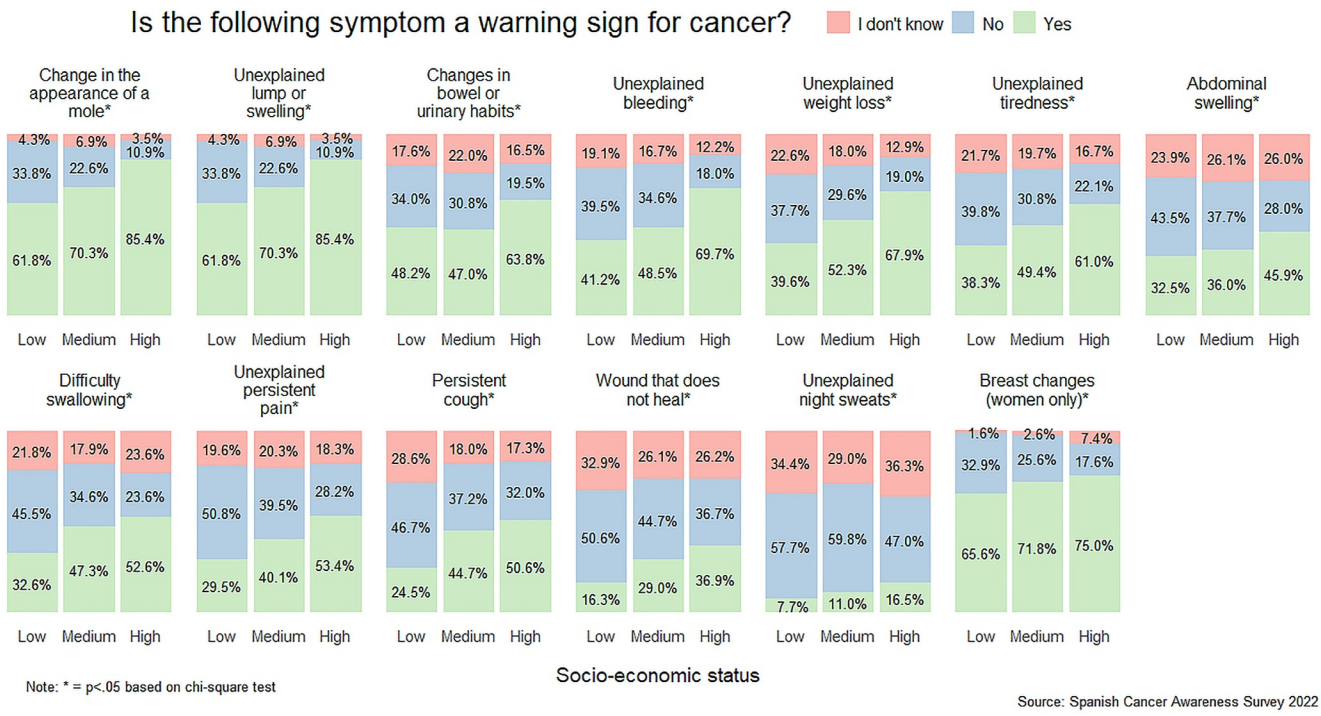

FIGURE 2 | Recognition of symptoms as a function of socio-economic status in the 2022 Spanish cancer awareness survey ($N = 1029$).

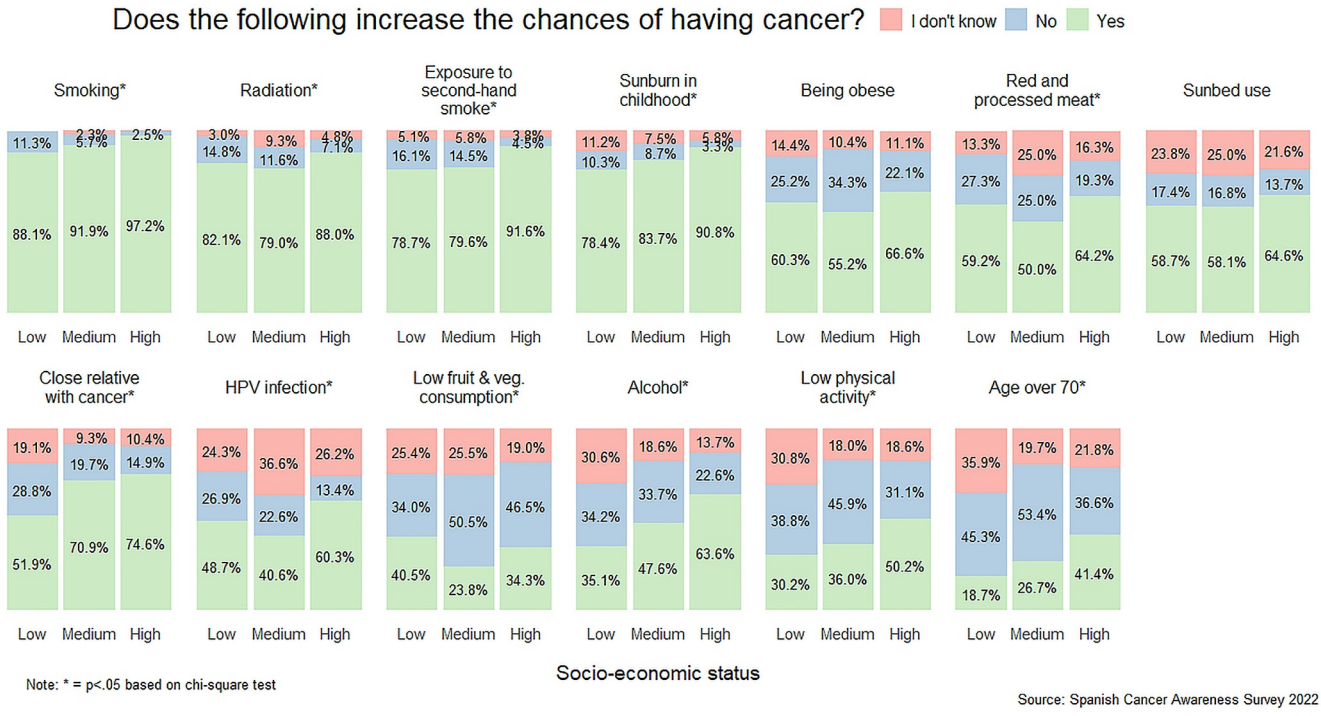

FIGURE 3 | Recognition of risk factors as a function of socio-economic status in the 2022 Spanish cancer awareness survey ($N = 1029$).

3.5 | Endorsement of Mythical Causes

People with low SES endorsed more mythical causes ($B = 1.75$, SE = 0.27, $p < 0.001$) than people with high SES (5.3 (SE = 0.2) versus 3.6 (SE = 0.3) items endorsed, respectively) (see Figure 4 and Supporting Information S1: Table S4). People with middle SES also endorsed more mythical causes than those from high SES ($B = 0.88$, SE = 0.31, $p = 0.005$). The largest SES effects were observed for the items microwave ovens, mobile phones, cleaning products, and electromagnetic frequencies. However, SES showed opposite effects on stress and trauma, such that people with high SES were more likely to endorse these items (Figure 4).

In addition, women and young adults (25–44 yo) endorsed a higher number of mythical causes compared to men and the remaining age groups, respectively.

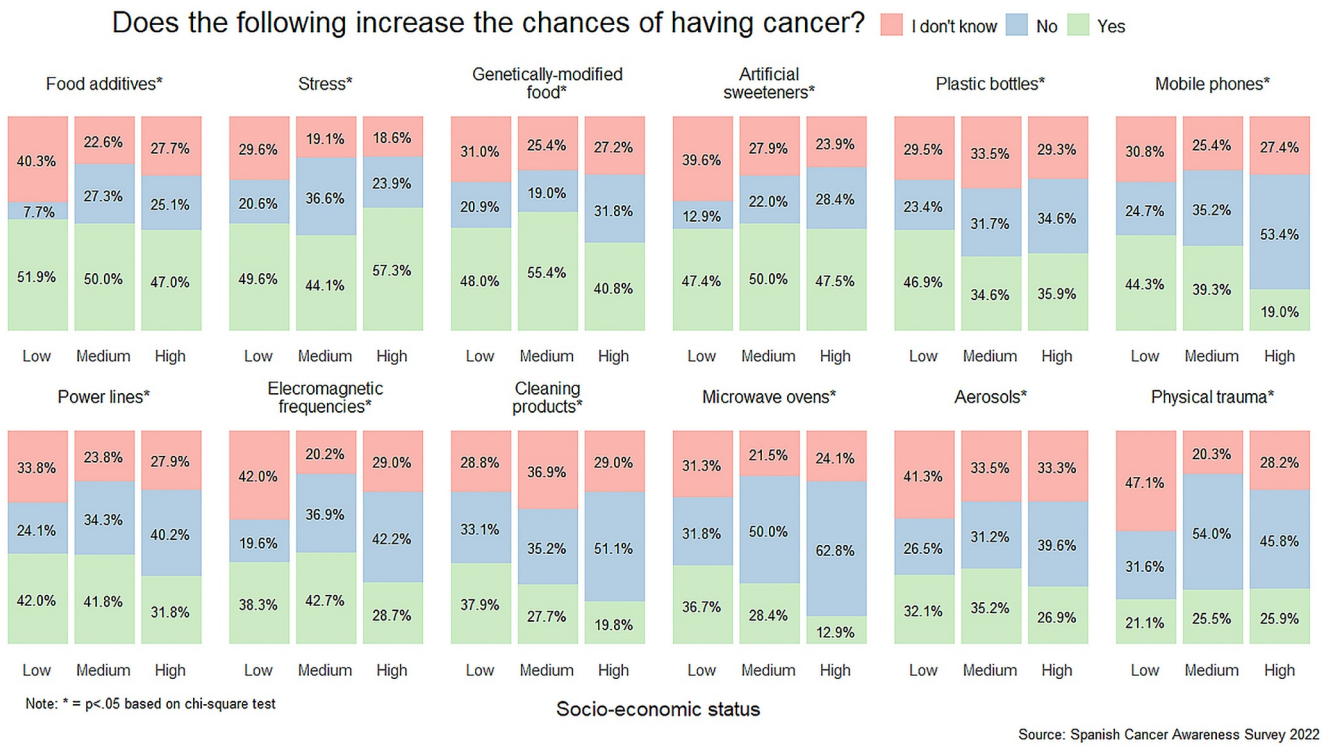

FIGURE 4 | Endorsement of cancer mythical causes as a function of socio-economic status in the 2022 Spanish cancer awareness survey ($N = 1029$).

4 | Discussion

We found large and consistent socio-economic inequalities in beliefs about cancer and its causes in the general population in Spain. Individuals with lower SES had less optimistic beliefs about cancer, recognized fewer symptoms and fewer risk factors, and endorsed more mythical causes of cancer.

Our results are in line with those from surveys conducted in the US [9], Denmark [36], and UK [35], showing that people with lower education or income are more likely to report fatalistic beliefs about cancer. However, these previous studies found no relationship between SES and positive beliefs about the disease. In contrast, we found that people with lower SES were less likely to believe that people with cancer can continue with their normal activities or that cancer can often be cured. These differences suggest that socio-economic inequalities in beliefs about cancer in Spain may be more pervasive that those in other high-income countries. Future research should explore the underlying reasons for different cancer beliefs among socio-economic groups. For instance, it has been suggested that people with lower SES may have witnessed poorer cancer outcomes among family, friends, or within wider social networks and, as a result, have more negative and less positive expectations about cancer [9]. Another contributing factor may be that cancers with worse prognosis such as lung, pancreatic, gallbladder, and head and neck cancer are more common among individuals with low SES [5, 35].

Consistent with previous research [9, 10, 37], people with lower SES recognized on average three symptoms fewer that people with high SES. These differences were present for virtually all 13 warning signs included in the questionnaire. Besides being less likely to recognize cancer symptoms, people with low SES were also more likely to mistakenly think that filler items were cancer warning signs. Lower knowledge of cancer symptoms has been associated with longer delays in seeking medical help when experiencing symptoms that could be cancer [38]. Lower symptom recognition may be partially contributing to inequalities observed on cancer outcomes, such as more advanced stage at diagnosis and lower survival among lower SES groups [6].

People with lower SES were less likely to recognize 11 out of 13 established risk factors for cancer, including modifiable risk factors included in cancer prevention recommendations (such as the European Code against Cancer) [3]. These findings are in line with some previous research [15–17, 24, 39] and suggest that cancer prevention efforts should be better targeted to reach more vulnerable groups. For instance, the item with largest SES disparities was alcohol. Conflicting health information, such as messages promoting the health benefits of moderate alcohol consumption, or the fact that wine is often considered part of the healthy Mediterranean diet consumed in Spain, may be contributing to the low awareness about the role of alcohol in cancer [40].

Another striking finding was that age was the least recognized cancer risk factor, especially among people with low SES, despite it being the strongest predictor of cancer risk. This discrepancy between reality and perceptions may be partially due to public health messaging that tends to prioritize modifiable risk factors like smoking, while non-modifiable factors such as age receive less emphasis. In addition, age is strongly underrepresented as a risk factor for cancer in the media, which can contribute to the public's limited awareness of its importance [41]. Improving

knowledge of age as a risk factor could improve cancer detection by contextualizing symptom interpretation among older adults, who are much more likely to have the disease [39].

Compared to other aspects of cancer awareness, endorsement of mythical causes of cancer is much less researched. Two previous studies from the UK [23] and Canada [24] found no SES differences, whereas another previous study from Spain found results similar to ours, showing that people with lower education endorse more mythical causes of cancer [22]. The largest SES differences were observed for items to which exposure is common in daily life including microwave ovens, mobile phones, and cleaning products.

Overall, people with lower SES are at a disadvantage when it comes to knowing how to act against cancer. Whereas some mythical causes were overall highly endorsed among people with low and high SES (e.g., power lines, genetically-modified foods...), the gap in knowledge regarding cancer causes was wider among people with low SES. To illustrate, people with low SES were more likely to endorse several mythical causes of cancer (e.g., plastic bottles endorsed by 46.9%, mobile phones 44.3%, microwave ovens 36.7%) than some established risk factors included in cancer prevention recommendations (e.g., low physical activity 30.2%, alcohol consumption 35.1%). Correcting mistaken beliefs about what causes cancer is important because it can interfere with effective prevention efforts. For instance, people may mistakenly feel that they are effectively protecting themselves or may dedicate time and energy to activities that have no bearing on cancer risk.

Our analysis further underscored the impact of other personal characteristics, such as sex, age, and personal and family cancer history on cancer awareness. For instance, women were more knowledgeable about cancer symptoms than men but endorsed more mythical cancer causes, in line with results from Australia [40] and the UK [23]. Previous studies have often found higher cancer awareness among women, consistent with a higher interest and engagement of women with healthcare services [37]. However, such higher interest could also expose women to more sources of misinformation (e.g., through social media), leading to beliefs in cancer myths in this population. For instance, breast cancer is one of the cancers with strongest media and social presence and news containing misleading content about breast cancer are three times more likely to be shared than news reporting verified content [42]. In our study, females also had a more negative outlook on cancer (more negative and less positive beliefs). Compared to men, women have lower risk of developing cancer and better cancer survival on average [43]. However, at the same time they are more likely to be caregivers for people with cancer, more likely to experience financial strain due to cancer, and may be more likely to engage with different types of cancer-related information [43], which might affect their perceptions of the disease.

4.1 | Study Limitations

A strength of this research is the evaluation of diverse aspects of cancer awareness in relation to SES. However, the two survey samples used were obtained using different sampling and data collection methods, limiting the direct comparability of results. Despite such differences, the consistent effects documented demonstrate the generalizability of the socio-economic gradient in cancer awareness across different samples and outcomes, offering stronger basis for any theoretical or practical implications of the research.

To address limitations related to the non-representativeness of the S-CAS, statistical weights were designed following validated methods (propensity score adjustment and calibration) that have been shown to reduce bias [32, 33]. Comparisons between the sex and age distribution of the two surveys and national population data from the National Institute of Statistics of Spain (see Supporting Information S1: Table S5) show that individuals between 18–24 and 55–64 years old have been underrepresented in both studies, and that females were overrepresented in the Oncobarometer.

The potential for selection bias is another limitation of the current research. For instance, people with personal or familial experiences with cancer may have been more motivated to participate in a survey about the disease.

"No" and "I don't know" responses were grouped for the purposes of regression analyses, without being able to differentiate the potentially more dangerous "no" from not knowing. The descriptive analysis (Figures 1–3) shows on what items people with low SES were more likely to choose "I don't know" as a response, however, there was no highly consistent pattern.

Another limitation is the use of education level as proxy for a broader socio-economic status assessment in the S-CAS. Despite capturing a similar socio-economic gradient to cancer awareness, the two SES measures are different in the type and amount of information considered. Education level is the most common measure used to capture SES in health research [35] and is considered to have an impact on both income and occupation [44]. In addition, educational level is considered the most important determinant of health literacy, mediating the relationship between SES and diverse health-related outcomes [44]. Overall, in a country with universal access to healthcare such as Spain, education could be a sensitive measure capturing differences in health-related knowledge such as those used in the current research. This may be different for other countries such as the US where income and occupation more strongly determine the access to healthcare and hence the quality and amount of interaction with the healthcare system. In Spain, research shows that the composite measure used in the Oncobarometer and the educational classification used in the S-CAS capture remarkably similar patterns of health behaviors related to cancer prevention [45].

4.2 | Clinical Implications

Interventions are needed to reduce the existing SES disparities. Several such interventions have been found to be effective at improving participation in cancer screening, for example [46]. Future research should explore to what extent addressing

disparities in awareness translates into reduction of inequalities in adherence to cancer prevention recommendations and other cancer outcomes. Modifiable risk factors including smoking, alcohol consumption, low fruit-and-vegetable intake, physical inactivity, and obesity were found to explain 45% of the associations between low SES and cancer morbidity and mortality [47]. However, individual-based behavioral strategies such as educational actions would only have limited effects on behavior if not accompanied by structural changes and appropriate policy initiatives [48]. To illustrate, population-based campaigns aiming to increase knowledge about cancer detection and prevention would have a higher likelihood of being successful if the behaviors encouraged are supported by legislative, regulatory, or fiscal policies [49].

Finally, socio-economic inequalities should be monitored to track progress and assess the effectiveness of cancer prevention efforts. In Europe, the European Commission launched the Cancer Inequalities Registry (https://cancer-inequalities.jrc.ec.europa.eu/). It provides data on socio-economic differences for multiple cancer-related behaviors and epidemiological indicators. The results of the current study support the relevance of cancer awareness indicators as potential useful additions to such databases tracking socio-economic inequalities.

5 | Conclusions

We have documented substantial socio-economic inequalities on diverse cancer awareness indicators in the general population of Spain, consistent with worse preparedness to act against cancer among lower socio-economic groups.

Author Contributions

S.I.G.P., A.C., D.P., and M.J.S. conceived the work. D.P., R.G.R., and D. G. translated and pretested the questionnaires. L.A.S., M.M.R., and M.R. B. collected data. S.I.G.P., L.A.S., and D.P. analyzed the data. S.I.G.P. and D.P. wrote the first draft of the manuscript. All authors contributed to data interpretation, revised the manuscript for critical content, and approved the final version of the manuscript.

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Ethics Statement

2020 Spanish Oncobarometer: this was an analysis of anonymized secondary data and informed consent was obtained from all respondents in accordance with the ICC/ESOMAR International Code on Market, Opinion and Social Research and Data Analytics (2016). 2022 Spanish Cancer Awareness Survey: this study was approved by the Provincial Research Ethics Committee of Granada, Spain, and participants' informed consent was obtained before starting the survey (SURVEY-CANCER1924/SICEIA-2024–000756).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The raw dataset for the 2020 Spanish Oncobarometer study can be requested from the Observatory of the Spanish Association against Cancer (Asociación Española contra el Cáncer: www.aecc.es). Aggregated data can be consulted on https://observatorio.contraelcancer.es/informes/oncobarometro. The raw dataset of the 2022 Spanish Cancer Awareness Survey and the Spanish versions of all instruments used are available on the Open Science Framework (OSF): https://doi.org/10.17605/OSF.IO/56FMU.

Endnotes

[1] To estimate the propensity scores, a logistic regression model was used based on those survey questions that were analogous to the Oncobarometer survey: all personal characteristics questions and two additional items about perceived health and healthy lifestyle that were administered for the purpose of generating the propensity scores. For calibration, we used the population totals of the socio-demographic variables sex, age, civil status, occupation, and education, obtained from the continuous population register of the Spanish Statistical Institute.

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Supporting Information

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