

Linguistic Framing in ‘Cancer’ and ‘Cancer’-Adjacent Terms

Abstract

Linguistic framing – the use of background conceptual knowledge to interpret language – is a foundational part of how language researchers understand meaning (Lakoff & Johnson 1980). The specific question we set out to answer concerns the overall trend of overdiagnosis and overtreatment of low-risk, screen-detected cancers and how the terminology used to diagnose them could minimize harm. We tested for a framing effect surrounding ‘cancer,’ using one term that is technically a synonym with ‘cancer’ (‘carcinoma’) and two terms that are potentially but not necessarily closely correlated with cancer: ‘tumor’ and ‘abnormal cells’. We observe that lay people are significantly more likely to associate ‘cancer’ with death and fear than its synonym ‘carcinoma,’ and that laypeople are also likely to erroneously interpret ‘tumor’ as synonymous with ‘cancer’ in a diagnostic context. While there are clear and known dangers of using medical jargon in diagnostic contexts (Deuster et al. 2008), we argue that this potential for miscommunication involving common terms like ‘cancer’ is even more insidious and potentially dangerous, because it comes without any signals of interpretive difference. Our findings support a number of recent papers and editorials that stress the dangers to patients of using the scientific label ‘cancer’ in cases of low-risk or non-canonical carcinoma (Essener & Eggerman 2023, Reddy 2024).

1. Introduction

The answer to the question of what precisely defines ‘cancer’ as a medical term is not as clear-cut as many would believe. The canonical attempt to define it, the 2000 paper “The Hallmarks of Cancer” (Hanahan & Weinberg 2000), does not succeed in providing an exceptionless definition, as emphasized by its several follow-up papers (Hanahan & Weinberg 2011, 2015, 2017), and by philosophical work on the metaphysics and ontology of cancer (Plutynski 2012, Rulli 2024) arguing that cancer does not comprise a natural class, and is therefore undefinable.

The absence of any clear-cut definition of what qualifies as a cancer leads, as a matter of natural course, to some conditions being labeled as a cancer despite not exhibiting properties we think of as prototypical (Eggener et al. 2022). This leads to countless cases of overtreatment of low-risk cancers (Reddy 2024), for example Grade Group 1 Prostate Cancer (Saoud et al. 2023); patients opting for intervention, at a higher risk, when the recommended treatment is active surveillance (i.e., the passive monitoring of the condition).

The question in the background of this paper is the following: in the context of low-risk cancers, what aspect of the over-treatment problem can be attributed to the linguistic framing of the term ‘cancer’? Our expectation, given research in linguistics, applied linguistics and philosophy of language (Ludlow 2014), as well as some recent pilot data (Rett et al. 2024), is that patients and their physicians differ on how they interpret the word ‘cancer’, and that patients are much more likely than medical professionals to consider cancer to be a deadly and painful monolith.

If we have evidence that patients’ understanding of the term ‘cancer’ differs greatly from the understanding of the term in the medical community, we can conclude that some appropriated common terms (like ‘cancer’, but perhaps also other terms, like ‘migraine’ or ‘psychosis’) have just as much potential to be a source of miscommunication as medical jargon. Our ultimate goal is to use this knowledge of variation to suggest alternative terms physicians could use in the diagnostic setting to reduce patient anxiety, promote active surveillance for low-risk cancers, and, most importantly, to encourage patients to ask further questions about their condition.

We use the standard tools of linguistic framing to try to quantify the extent to which patients and prospective patients interpret the word ‘cancer,’ as well as its potential synonyms. We ask the following questions: How do different terms for low-risk cancers influence participants’ anxiety and perceived knowledge of the condition?; Is it likely that alternative terminology could reduce the likelihood of overtreatment?; and If so, which ‘cancer’-adjacent term would be the best to recommend for clinical trials to use in the place of ‘cancer’ for these low-risk diagnoses?

2. Previous Research

2.1 Linguistic Framing

We take as our starting point studies in communication on linguistic framing: the idea that how information is presented may be as important as what is being said. One recent, pertinent experiment compared subjects’ reactions to different terms characterizing carbon emissions, like ‘greenhouse gas emissions’ and ‘carbon pollution’, concluding that ‘carbon pollution’ and ‘carbon emissions,’ by virtue of the fact that they contain the word ‘carbon,’ framed the phenomenon in a scarier and more harmful light (Commerçon et al., 2023). Another finding with very serious implications showed subjects displayed significantly more negative attitudes towards the term ‘torture’ than ‘enhanced interrogation,’ even given identical descriptions of the tactics (Rios & Mischkowski, 2019). This greater negativity in response to the word ‘torture’ extended to effects ranging from emotional distress to actual behaviors like signing petitions.

Our present goal is to adapt these methodologies to the term ‘cancer’ more generally and to what we perceive to be some of its closest semantic competitors. Any evidence of variation will shore up and quantify our default assumption of variation and context-sensitivity we inherit from

linguistics and philosophy, and can inform future studies on how to address the problems of overtreatment and overdiagnosis.

2.2 Cancer-specific patient surveys

Several recent studies have surveyed patients or potential patients about terms for specific conditions (in hypothetical scenarios); all report at least tentative evidence that patients behave differently when their diagnosis involves the word ‘cancer’ than when it does not.

Several surveys that directly poll subjects’ impressions of the word ‘cancer’ conclude that it invokes intense fear, anxiety, and shock in patients (Lyons et al. 2024) and potential patients (Jensen & Pitt 2021).

Several other studies investigate patients’ and potential patients’ reaction to the term ‘cancer’ in a hypothetical diagnosis scenario. One concluded that subjects choose more invasive hypothetical treatment options when the term ‘papillary thyroid cancer’ was used to characterize their hypothetical condition, as opposed to the terms ‘papillary lesion’ or ‘abnormal cells’ (Nickel et al., 2018). Another compared subjects’ treatment decisions and anxiety levels about a hypothetical diagnosis of a small thyroid lesion, using the terms ‘cancer,’ ‘nodule,’ or ‘tumor’ in the vignette (Dixon et al. 2019), concluding that “the cancer disease label played a considerable role in respondent decision making independent of treatment offered and risk of progression or recurrence”. A similar survey compared ‘cancer,’ ‘neoplasm,’ ‘tumor’ and ‘growth’ in a hypothetical prostate-cancer diagnosis scenario, along with biopsy descriptors, and found an effect of condition term (Berlin et al. 2023).

2.3 Medical Jargon vs. Common Terms

It is widely recognized that the use of medical jargon in diagnostic contexts is problematic (Deuster et al. 2008, Howard et al. 2013, Links et al. 2019, Pitt & Hendrickson 2020). However, unlike medical jargon, common terms like ‘cancer’ gain a reputation and emotional associations through their colloquial use. ‘Cancer’, for example, is used in everyday speech as a metaphor for destruction (Penson et al. 2004, Potts & Semino 2019).

We argue that this potential for miscommunication, involving common terms, is even more insidious and potentially dangerous. Medical jargon does obscure meaning for patients, making it difficult for them to understand the details of their condition and care, but common terms that lack any precise society-wide definition are equally as confusing, but in a hidden way. While patients might be confused about the meaning of medical jargon, they will likely not feel confused about a common one, even if they should. As a result, it seems reasonable to think that patients are less likely to ask follow-up questions or conduct their own research to understand the reality of their condition if it is presented to them with a common term like ‘cancer’ than if it is

presented with a jargon term like ‘microcarcinoma’. As a result, there is plausibly more room for miscommunication with common terms than with medical jargon.

3. Methods

3.1 Sample and Design

We surveyed a random sample of native English speakers living in America over the age of 18 ($N = 1600$). Subjects were recruited and paid through Prolific, and the survey was hosted by Qualtrics. Respondents were randomly assigned to one of four surveys each featuring a different term associated with cancer: *cancer* ($n = 416$), *carcinoma* ($n = 420$), *tumor* ($n = 410$), and *abnormal cells* ($n = 408$), making the term a between-subjects condition. Each set of questions differed only by the use of the chosen terminology to describe the condition and small grammar adjustments. Through the platform, respondents were randomly divided (approximately) evenly by gender into the four conditions. Participants were compensated \$5 for completing the ten-minute survey. Before the term-specific questions, participants were asked to fill out a short demographic questionnaire. At the very end of the survey, they recorded their personal experience with receiving a cancer diagnosis for themselves and friends or family. A full list of the precise wording of the questions can be found in our appendix.

We chose three terms to test in addition to the word ‘cancer’. The inclusion of ‘carcinoma’ was based on the assumption that it is synonymous with ‘cancer’, but a technical term (or jargon) instead of a common one. We chose ‘tumor’ based on the suspicion that lay people might both know that a tumor can be benign and still have an anxious reaction to the word. The final term, ‘abnormal cells’, is our best guess at a term that is a technically sufficient description of cancer, but without historical or contextual associations.

3.2 Measures

The survey questions were created to both directly and indirectly measure respondents' relationship to their term (*cancer*, *carcinoma*, *tumor*, or *abnormal cells*) focusing on four semantic and framing factors: 1) their familiarity with the term; 2) their anxiety about the term; 3) the pain they associated with the term; and 4) their perceived severity/mortality of the term. The questions are reproduced in full in the Appendix; Table 1 shows which questions inform these four factors, along with which questions pertain to general term knowledge.

[TABLE 1 HERE]

Questions 1, 2 and 19 measured the extent to which a subject is familiar with their term. Questions 4 – 5, 8 – 9, and 17 measured diagnosis anxiety and general affect around the condition terms on anchored scales from 1-7 (ex. 'not worried' to 'very worried') as well as an open-ended question to collect top-of-mind responses. To control for subjects' baseline anxiety about being sick, we asked about how often they worry about their health in general, as well as questions regarding their loved ones' conditions instead of their own diagnosis.

The rest of the questions were intended to measure the respondent's understanding of their term, specifically asking about treatment, pain, prognosis, spread, symptoms, and prevention based on the respondent's previous (or lack of) knowledge on the specific terminology presented. For instance, Questions 6 and 10 elicited information about the extent to which subjects associated the term with pain, and Questions 6, 11, 14-16, and 18 tested the anxiety associated with the term (either in a subject's own hypothetical diagnosis, or that of a loved one). Unlike some prior studies, these terms are presented without context or explanation, so the survey directly tests the linguistic frames associated with the terms, not their knowledge of the condition denoted by the term, nor their interpretation of the medical science behind the condition.

In addition to the direct and indirect scale questions, Q3 and Q6 were open response prompts, asking for top-of-mind words and symptoms subjects associated with their term. In developing these questions and response choices, we consulted with two collaborators: an oncological surgeon and an endocrine surgeon.

3.3 Data Analysis

For the Likert-scale questions, we computed response averages (out of 7) for each question, separating the data into the four term condition groups. We also partitioned the data by demographic responses to check for any glaring differences across the conditions due to different factors.

In this study, individual variance for each question (separated by term condition) was calculated by determining the mean of the responses, followed by computing the squared differences between each response and the mean. These squared differences were then averaged to yield the individual variance. The overall average variance per term group – Cancer (2.59), Tumor (2.72), Abnormal Cells (2.78), and Carcinoma (3.17) – was subsequently obtained by averaging the individual variances within each group, providing a measure of the group's collective variability. With the lowest measure of variance, the 'cancer' group was the most aligned in what they believed to know about a cancer diagnosis.

We used ANOVA tests (Omega Squared metric, Table 2) in R Studio to determine the effect sizes of term, demographic factors, and participant history. One-sided tests provided a single number to quantify the effect one factor had on a question's responses.

[TABLE 2 HERE]

For example, as seen in Table 3, when modeling the effect of gender (gender_F) on the mean answers for Question 1 (familiarity), our equation presents an effect size of 0.03, falling between the small and medium associations in our metric. This tells us that gender had a small, but visible impact on how familiar respondents were with the terms.

[TABLE 3 HERE]

Two-sided ANOVA tests were also used to calculate the interaction effects of certain factors on each other. This included testing for any demographic trait or personal history that might have had an effect on how the question answers differed by term. Two-way tests were also important to rule out any significant interactions that might indicate the inability to generalize or if any certain groups needed to be isolated. In Table 4, the results of the two-way test for gender and term's interaction for Question 5 (anxiety) reveal there is no significant interaction, allowing us to assume the results for term's effect can be generalized for all recorded genders.

[TABLE 4 HERE]

For the open-ended responses questions (Q3 and Q6), we devised a 'codebook'. This enabled us to tally the free word responses by semantic groups, categorizing and counting responses based on their meaning or thematic content. The semantic categories represented the various concepts the responses expressed, developed based both on the research objectives and a preliminary analysis of the responses. An example would be the symptom category 'pain' which would tally any responses pertaining to 'ache', 'pain', 'soreness', etc. Each response was then individually reviewed and assigned to one existing category or warranted the addition of a new one if it introduced a unique idea or theme. This method presented a clear picture of what types of responses were seen across the four conditions and their spread.

4. Results

4.1 Demographic and Control Factors

Our subjects were, by design, fairly diverse in terms of gender, race, class, and educational background (see Figure 1).

[FIGURE 1 HERE]

But we found that they did not differ very much across these categories in terms of their understanding of the relevant terms (almost none of these demographic differences had an effect size over 0.02). The two participant factors with the biggest effects were gender and personal experience (Tables 5 and 6). In comparison to other genders, men tended to request the most

explanation for each term as a diagnosis; predicted they would spend less time worrying about contracting any condition; and imagined there is less pain involved across the board.

[TABLE 5 HERE]

[TABLE 6 HERE]

Those whose loved ones had received a cancer diagnosis were, unsurprisingly, more familiar with the test terms and more anxious about the conditions associated with them. Subjects with personal cancer history were more likely to worry about all conditions more often (Q5), and were greatly more familiar with carcinoma and abnormal cells than those without any history (Table 7).

[TABLE 7 HERE]

Education, salary, and healthcare background all had a surprisingly low effect on subjects' responses. Though a small effect, people with a healthcare professional background had more familiarity with the terms (0.03 effect) and had more anxiety surrounding the conditions in everyday life (0.01 effect).

We conducted the two-way tests to examine whether having a personal or professional history with cancer influenced how participants responded to the different term conditions. Interestingly, the interaction effect was minimal (ranging from 0 to 0.02), indicating that even individuals with a background in cancer, who might be expected to have a deeper understanding of these terms, did not perceive or respond to them as distinctly as their definitions would suggest. This suggests that prior experience with cancer did not significantly alter the impact of the term conditions on participants' responses.

4.2 Main effect of term

As expected, we saw a large main effect of term, meaning that subjects answered questions significantly differently depending on whether they were in the 'cancer' condition or one of the other synonyms. Statistical analysis showed the term had an immense effect on the familiarity question (0.36), medium to large effects on the pain (0.12) and anxiety (0.07) questions, and a small effect on severity (0.04) questions. This is notable, as we will see in detail, in part based on the fact that many in the medical community consider 'cancer' and 'carcinoma,' if not 'abnormal cells', to be entirely synonymous, and it reinforces the perception that our questions addressed the linguistic framing, rather than technical understanding, of the terms.

4.2.1 Term 1 - 'Cancer'

In comparison to the other terms, subjects in the 'cancer' condition recorded feeling the most familiar, most worried, and least confused about their term. The 'cancer' participants also

displayed the highest averages on questions testing their assessments of the pain and severity associated with the term (Figure 2). As recorded above, the responses in this condition had the lowest total variance numbers across the numeric questions; this suggests that people are most united in their assessment of ‘cancer’ in relation to our four factors (familiarity, pain, severity and anxiety).

[FIGURE 2 HERE]

Figure 3 looks at the most frequent open-ended responses to the symptom (Q6) and top-of-mind (Q3) questions in the ‘cancer’ condition. These questions asked participants to send in written free responses and our codebook grouped these answers to see the most common themes and patterns. Subjects’ immediate response to the term ‘cancer’ was alarming: over 25% of subjects wrote ‘death’ (or an adjacent term, like ‘fatal’) when given the opportunity to submit a single word association. Interestingly, the response ‘tumor’ turned up third most often to this same prompt, supporting the strong link between ‘cancer’ and ‘tumor’ in subjects’ minds.

[FIGURE 3 HERE]

To gain more insight, in Question 12 we also asked “Given what you know about cancer, what sort of treatment would you expect a patient to need?” and allowed participants to choose all that apply from the options (see Appendix). 70% of participants selected either ‘chemotherapy and surgery’ or ‘chemotherapy, surgery and oral medication’. This gives us further insight to how people perceive the severity and possible variability of cancer.

4.2.2 Term 2 - ‘Carcinoma’

Despite being synonyms in the medical community, our subjects did not treat ‘cancer’ and ‘carcinoma’ as entirely synonymous, although they do consider ‘carcinoma’ to be severe and scary in its own right.

Figure 4 looks at the most frequent open-ended responses to Questions 6 and 3 in the ‘carcinoma’ condition. While some terms like ‘pain’ and ‘fatigue’ were also common in the ‘cancer’ condition (Figure 3), the high frequency of others (like ‘skin changes’) and the low frequency of words surrounding fatality, suggest the general public does not see the two conditions as having the same physical effect or prognosis. The mean discrepancies for familiarity and anxiety questions (Figure 2) show further that ‘carcinoma’ is not a term subjects are as familiar with, or are as anxious about, as ‘cancer’.

[FIGURE 4 HERE]

This relative lack of overall anxiety regarding ‘carcinoma’ (in contrast with ‘cancer’) is consistent with the assumption that ‘cancer’ has outsized and unusually negative linguistic framing. However, despite being relatively unfamiliar with the term and its definition, we have

found that subjects still have the gut reaction that 'carcinoma' serious and severe; all respondents on average ranked 'carcinoma' second highest (below 'cancer') in metrics for severity and pain. This includes both the Likert scale questions and the final direct ranked severity question (Q18).

In sum, despite 'carcinoma' being viewed in the medical community as synonymous with the term 'cancer', patients seem to treat it differently than 'cancer' in just the ways we'd expect from a difference in framing. Subjects conceive of 'carcinoma' as a serious term for a severe condition – this effect may be drawn in part from its status as medical jargon – but it still places second to 'cancer' in subjects' anxiety and perception of the scariness of the condition.

4.2.3 Term 3 - 'Tumor'

It's clear to a medical professional that a tumor can be cancerous or not, and a cancer can be a tumor or not (there are, for instance, microcarcinomas and blood cancers that don't form lumps). However, our evidence suggests that the meanings of the terms 'cancer' and 'tumor' – or at least the linguistic frames associated with the two terms – are closer together in the public perception than those in the medical profession might think. According to our findings, people treat the terms 'cancer' and 'tumor' with comparable levels of recognition and worry.

While 'carcinoma' revealed similar responses to 'cancer' for our two factors of severity and pain, 'tumor' does the opposite. As you can see in Figure 1, the numerical responses for questions regarding familiarity and anxiety are closest in the 'tumor' and 'cancer' conditions. This is consistent with other questions (Q2, Q8) testing the same factors.

The open-ended symptom responses revealed more perceived similarities between the 'tumor' and 'cancer' conditions—with five of six most common answers matching. This is in notable contrast to the 'carcinoma' condition, giving evidence that there exists a more commonly believed attachment from 'cancer' to 'tumor' in the public's mind.

[FIGURE 5 HERE]

4.2.4 Term 4 - 'Abnormal Cells'

We included the term 'abnormal cells' because it seems to describe a condition medically quite similar to 'cancer', but we expected subjects to have little or no linguistic frames associated with it. And indeed, 'abnormal cells' scored similarly to 'cancer' in the written symptoms response question (Figure 6).

[FIGURE 6 HERE]

For weakness, nausea, and fatigue, three of the most common symptoms seen from the ‘cancer’ condition, ‘abnormal cells’ was the closest of all to ‘cancer’ in the number of responses (Figure 7). This suggests that subjects do identify the two conditions as medically similar.

[FIGURE 7 HERE]

However, despite these similar symptom reports, ‘cancer’ ranked highest in every metric for familiarity, anxiety, pain, and severity, while ‘abnormal cells’ was consistently ranked lowest (or near lowest). This confirms our suspicion that subjects – and patients at large – have fewer linguistic frames, or less emotional baggage, associated with the term ‘abnormal cells,’ all while thinking of it as medically or scientifically similar to ‘cancer’.

Two questions, Q8 and Q16, deal very directly with the specific goal of our study—to suggest a cancer-like term that would lessen panic in a diagnostic setting and avoid overtreatment. Participants in the ‘abnormal cells’ condition rated their anxiety (if hypothetically diagnosed) the *lowest* and their comfortability with surviving without treatment the *highest* (Table 8).

4.3 Overall Rank Question

We asked each subject, at the end of their term survey, to rank the four test words in terms of severity, position #1 being the most severe (Figure 8).

[FIGURE 8 HERE]

Terms ‘tumor’ and ‘carcinoma’ were the only two that had major mobility in rank across respondents, with ‘tumor’ being marked second by 34% of participants. We did a cross-analysis of these statistics in each term condition as well to see if there was any significant effect on how they were ranked due to which term the participant had been thinking about for the entire survey before responding. We found that in the ‘abnormal cells’ condition there was the most mobility between the three terms, but ‘cancer’ stayed firmly in first place. This might suggest that people are more likely to think a condition is more severe when they have had greater exposure to its term.

5. Discussion

5.1 Interpretation of Results

Our goal in this study was not to test subjects’ textbook understanding of the terms, or their response to the use of the term in a specific hypothetical diagnosis condition, but instead to gauge how they interpreted the term in the absence of any additional information about the condition it was labeling.

The clearest conclusion is that subjects find the term ‘cancer’ to be consistently anxiety-producing, and associate it consistently and strongly with severe and painful conditions. It was ranked as by far the most severe condition, with the other three terms clustering together much lower on the scale. And it was far more likely to be associated with death and fatality in our word association question.

Importantly, ‘cancer’ was also the term for which subjects reported the most confidence in their understanding (Q2). Not only did participants self-report their confidence, but the ‘cancer’ condition having the lowest variance in responses shows they were also unified in this understanding. This suggests that, while a less familiar jargon term like ‘carcinoma’ or ‘lymphoma’ might prompt a patient to ask questions about the label, patients will be significantly less likely to ask questions about a diagnosis label of ‘cancer’, despite the fact that they have an equally poor understanding of it (or a similar understanding of it) as they do the word ‘carcinoma’.

Relatedly, we saw surprising evidence that patients don’t conceive of the words ‘cancer’ and ‘carcinoma’ as strictly synonymous, as their medical practitioners do. ‘Carcinoma’ was less familiar to our subjects than ‘cancer,’ but it was ranked as significantly less anxiety-producing than the word ‘cancer’, even below ‘tumor’. Finally, in our open-ended questions about word associations with the test term, ‘cancer’ elicited significantly more associates related to death and dying than ‘carcinoma’ did, and ‘carcinoma’ elicited significantly different symptom associates than ‘cancer’ and ‘tumor’ (which patterned together) did. We believe this is a clear demonstration that patients have at least slightly different conceptualizations of the terms ‘cancer’ and ‘carcinoma’, and thereby that medical practitioners can’t use them interchangeably, for reasons above and beyond their different status as (non-)technical terms.

In contrast, the term ‘tumor’ patterned together relatively closely with ‘cancer’ in a surprising way. The term was ranked effectively as equally familiar as ‘cancer’, and scored the closest to ‘cancer’ in terms of how anxiety-producing it is, although it scored better than ‘cancer’ and ‘carcinoma’ (and at times even ‘abnormal cells’) in questions about pain and severity. Together, we believe that this strongly suggests that medical professionals should be aware that terms like ‘tumor’ (and perhaps related terms like ‘lump,’ ‘cyst’ or ‘growth’) could provoke an unhelpfully anxious response from a patient even in cases in which the diagnosis or pathology report specifies that the tumor is benign.

Finally, we piloted the term ‘abnormal cells’ in this survey as a potential medically accurate but negative-associations-free substitute for ‘cancer’ in diagnosis deliveries for low-risk cancers, i.e. ones in which the average patient’s associations with the word ‘cancer’ would be unhelpfully alarmist. And we’ve received at least preliminary evidence that it could be helpful in this respect.

We've found an appealing difference between how subjects define the phrase 'abnormal cells,' on the one hand, and how they conceptualize the term, on the other. Our data suggest that patients think of 'cancer' and 'abnormal cells' as describing conditions with similar symptoms and treatment requirements, but associate the term 'abnormal cells' with the least amount of pain and severity of the other terms in the study (see Figure 9). Also importantly, they report it as a term for which they are the least familiar. We interpret this to mean that the term 'abnormal cells' in a diagnostic setting would, helpfully, act as a conversation-starter, whereas the potentially synonymous term 'cancer' would act as a conversation-ender, with negative consequences.

5.2 Implications for Clinical Practice

Our findings support the hypothesis that the term 'cancer' elicits stronger negative emotions and more severe associations than its synonyms or related terms. It is a clear instance for which the concept of linguistic framing is useful for differentiating meaningfully between terms that might be thought of as semantically equivalent.

The data also give insight into the public's understanding of what a cancer diagnosis entails, demonstrating in real and quantifiable ways that the word itself – not just the diagnosis – elicits extreme and negative reactions.

It is therefore a mistake for medical professionals to assume they are on the same page with a patient when they use the term 'cancer,' despite the fact that they might be in a situation in which the patient reports confidently that they know what the term means. It is crucial that they are aware of the emotional power behind the word, and consider using alternative terms like 'abnormal cells' for a diagnosis when it's clinically appropriate, especially for low-risk conditions that do not match the stereotypical image of cancer, to reduce patient anxiety and avoid overtreatment.

There are many scientists and medical professionals making arguments in favor of reclassifying lower-risk cancers (Eggerer et al. 2022, Esserman & Eggerer 2023); our study suggests that nomenclature changes would be extremely beneficial to patients, and could potentially combat overtreatment by directly targeting patients' negative associations with the term 'cancer'.

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Figures and Tables

Table 1. Survey measures.

Measure	Questions	Example
term familiarity	1, 2, 19	<i>If your friend told you that they were diagnosed with x, how much more explanation of the condition would you need to understand what is happening in their life?</i>
term anxiety	4, 5, 8, 9	<i>How often do you find yourself worrying about developing x?</i>
perceived severity	11, 14-16, 18	<i>If you received a x diagnosis, how likely do you think you would be to survive without treatment?</i>
perceived pain	6, 10	<i>Given what you know about x, how painful do you think it would be?</i>
general term knowledge	6, 7, 11-16	<i>To what extent do you feel you could prevent developing x by taking precautions in your daily life?</i>

Table 2: Omega squared metric

key	
0.01	small association
0.06	medium association
0.14	large association

Table 3: Example one-sided ANOVA result (gender : Q1)

Parameter	Omega2	95% CI
gender_F	0.03	[0.01, 1.00]

Table 4: Example two-sided ANOVA result (gender : term : Q5)

Parameter	Omega2 (partial)	95% CI
gender_F	0.03	[0.01, 1.00]
term_F	0.07	[0.05, 1.00]
gender_F:term_F	3.54e-03	[0.00, 1.00]

Table 5: Gender effect sizes on numerical survey responses across all term conditions

	Q1	Q2	Q4	Q5	Q7	Q8	Q9	Q10	Q15	Q16	Q17
gender	0.04	0.02	0.04	0.04	0.02	0.03	0.03	0.03	0.01	0.01	0.01

Table 6: Experience with cancer effect sizes on numerical survey responses across all term conditions

	Q1	Q2	Q4	Q5	Q7	Q8	Q9	Q10	Q15	Q16	Q17
personal cancer experience	0	0	0.01	0.06	0	0.01	0.01	0	0	0	0
cancer experience w/ a loved-one	0.04	0.01	0.03	0.08	0	0	0.01	0.01	0	0	0.01

Table 7: Effect of cancer experience across conditions

Question 1 mean responses		Tumor	Carcinoma	Cancer	Abnormal cells
personal cancer experience	no experience (0/7)	5.838	3.623	6.308	3.01
	some to high experience (4+/7)	6.037	5.048	6.4	4.364
cancer experience w/ a loved-one	no experience (0/7)	5.788	2.66	6.014	2.55
	some to high experience (4+/7)	5.99	4.39	6.44	3.82

Table 8: Likert averages for Questions 8 and 16

	Tumor	Carcinoma	Cancer	Abnormal cells
Q8 - If you were to receive news that you have x, how worried would you be?	5.47	5.34	5.73	5.3
Q16 - If you received a x diagnosis, how likely do you think you would be to survive without treatment?	2.07	1.95	1.35	2.18

Figure 1: Subjects' demographics

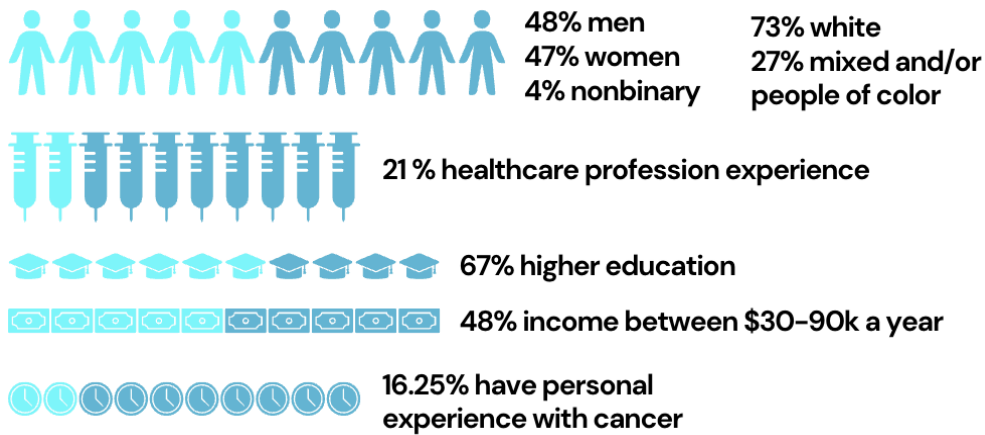


Figure 2: Likert scale question averages

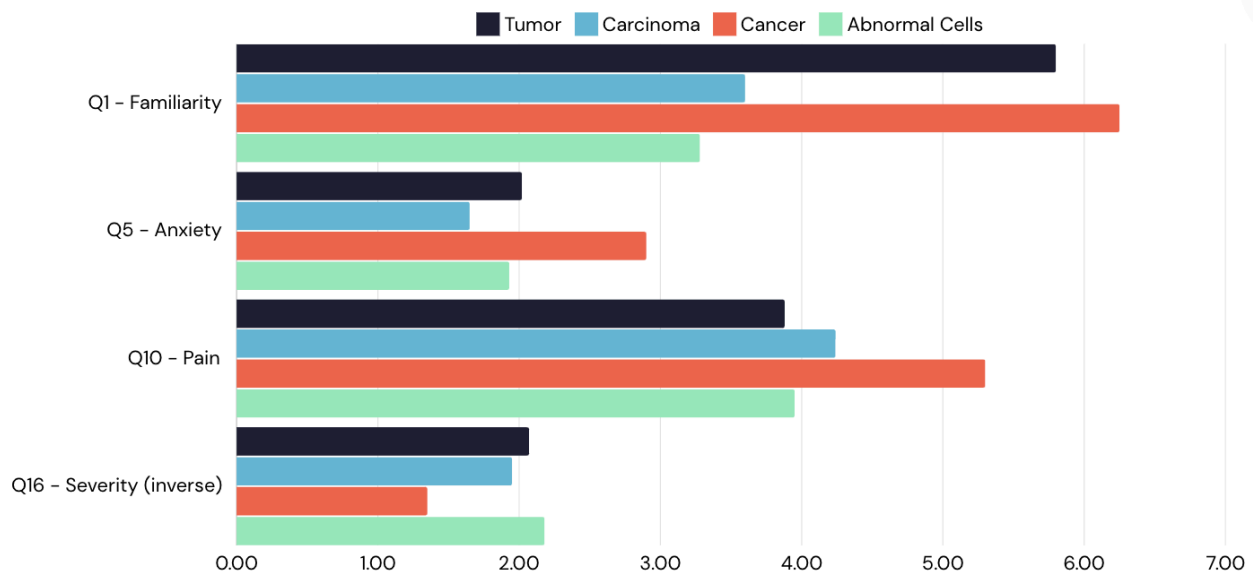


Figure 3: 'Cancer' open-ended common responses

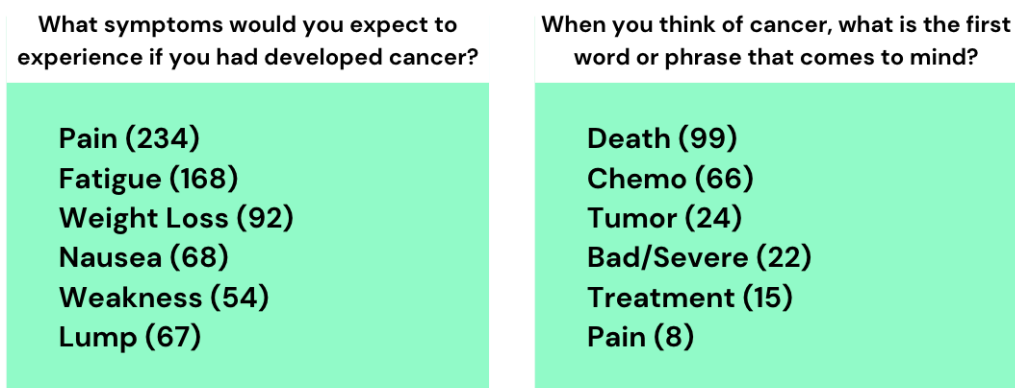


Figure 4: 'Carcinoma' open-ended common responses

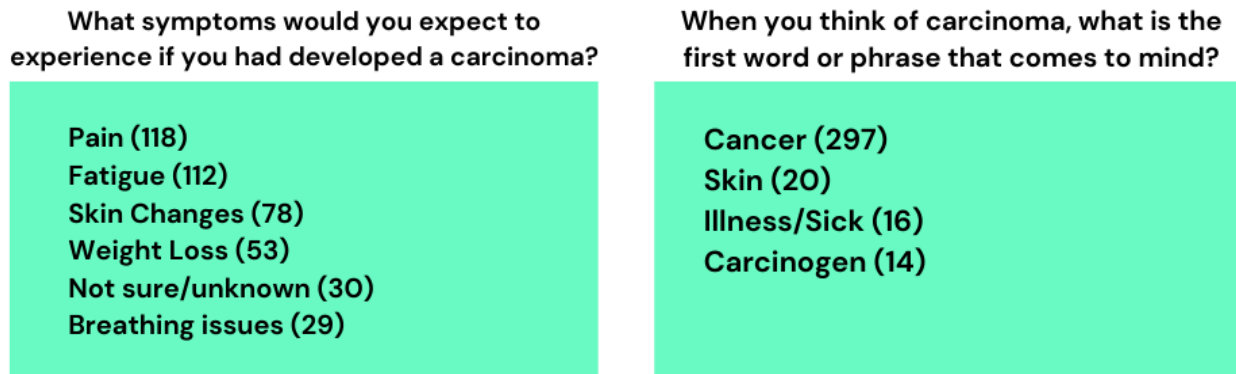


Figure 5: 'Tumor' open-ended common responses

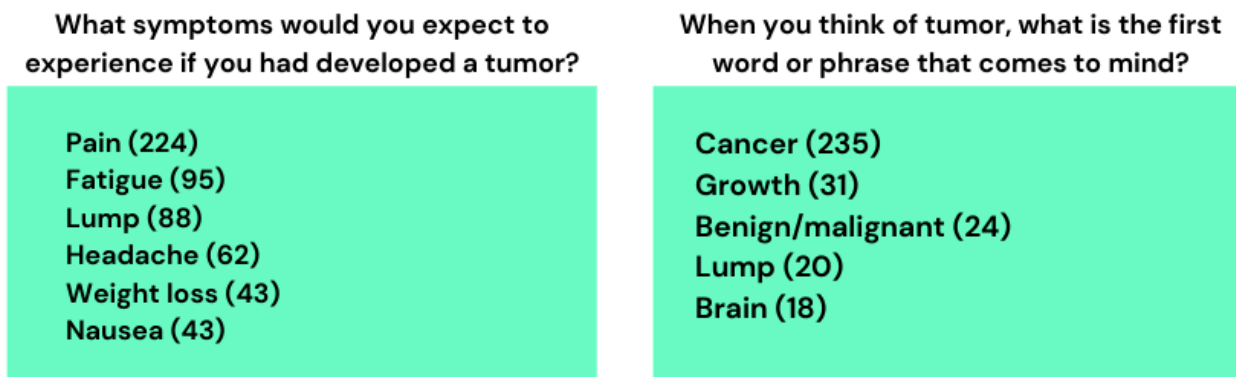


Figure 6: 'Abnormal cells' open-ended common responses

What symptoms would you expect to experience if you had developed abnormal cells?

Fatigue (158)
 Pain (150)
 Nausea (62)
 Weight loss (62)
 Weakness (45)
 Unusual/random (30)

When you think of abnormal cells, what is the first word or phrase that comes to mind?

Cancer (256)
 Illness (21)
 Anemia (18)
 Cells (13)
 Unusual/strange (12)

Figure 7: Symptom responses comparison across term conditions

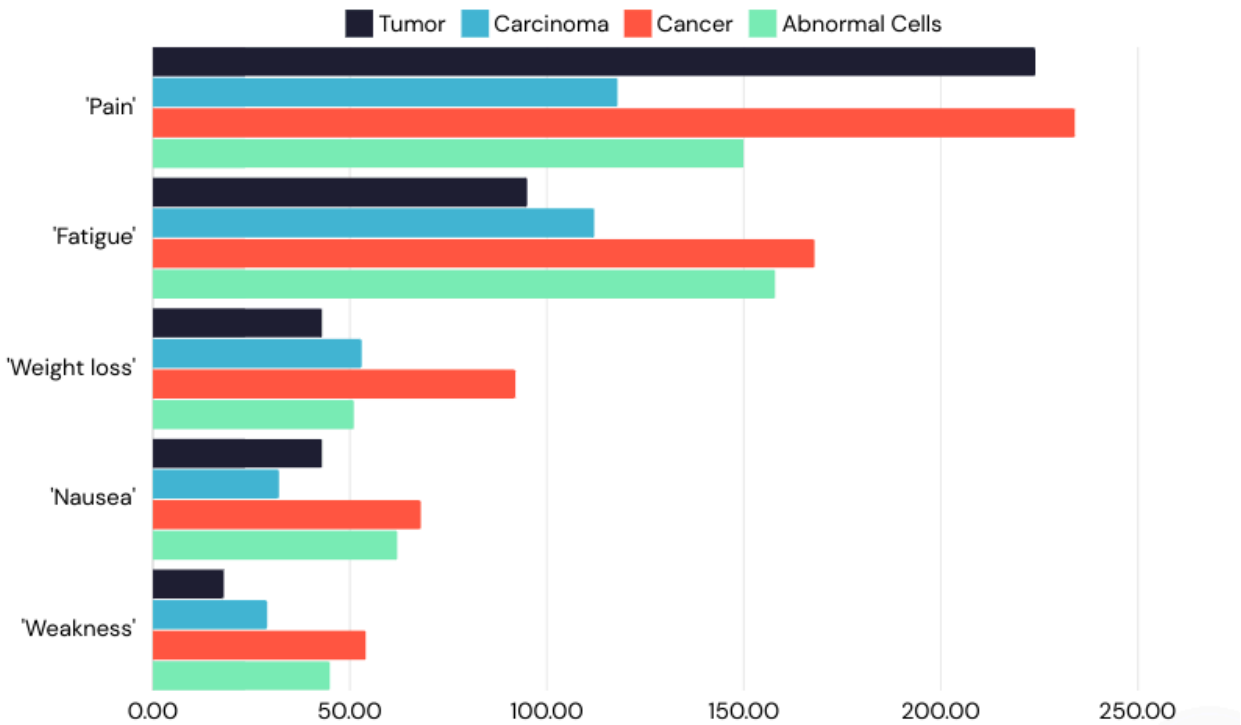


Figure 8: Severity ranking

Percentages are the total participants that placed term 'x' in position # y

1. 'cancer' (81.7%)
2. 'carcinoma' (45.1%)
3. 'tumor' (43.8%)
4. 'abnormal cells' (63.1%)

Appendix

Q1_1	How familiar are you with the term "x"? - I am...
Q2_1	If your friend told you that they were diagnosed with x, how much more explanation of the condition would you need to understand what is happening in their life?
Q3	When you think of x, what is the first word or phrase that comes to mind?
Q4_1	How often do you find yourself worrying about your health?
Q5_1	How often do you find yourself worrying about developing x?
Q6	What symptoms would you expect to experience if you had developed x? (separate symptoms with commas)
Q7_1	To what extent do you feel you could prevent developing x by taking precautions in your daily life?
Q8_1	If you were to receive news that you have x, how worried would you be?
Q9_1	If you were to receive news that you have x, how worried would you be that it had or would be passed on to one of your relatives? (1-7)
Q10_1	Given what you know about x, how painful do you think it would be?
Q11	Given what you know about x, how long would you expect treatment to take?
Q12	Given what you know about x, what sort of treatment would you expect a patient to need? (Choose all that apply) - Chemotherapy, Surgery, Organ transplant, Oral medication(like steroids or antibiotics), Gene therapy, No known treatment/untreatable
Q13	Given what you know about x, would you expect x to spread to other parts of your body?
Q14_1	How quickly would you expect it to spread?
Q15_1	If you received a x diagnosis, how likely do you think you would be to survive with treatment?
Q16_1	If you received a x diagnosis, how likely do you think you would be to survive without treatment?
Q17_1	How willing would you be to donate to a friend's crowdfunding campaign if their message read, "Seeking money for treatment of my x diagnosis"?
Q18_1	Based on your knowledge, how would you rank the severity of the following conditions? - Cancer, Abnormal Cells, Carcinoma, Tumor
Q19_1	How much experience have you had receiving a cancer diagnosis... - for yourself?
Q19_2	How much experience have you had receiving a cancer diagnosis... - for a close friend or family member?