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Clinical laboratory–based indicators of psychosocial vulnerability among hospitalised oncology patients

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Abstract: Psychosocial vulnerability plays an important role in shaping clinical trajectories and patient experience in oncology, yet its early identification during hospitalisation remains challenging. This retrospective observational study examined whether routinely collected laboratory data could be organised into a composite indicator of psychosocial vulnerability among hospitalised patients with tumour related conditions. Admission laboratory parameters across hepatic, renal, urinary, and haematologic domains were integrated to derive a laboratory based psychosocial vulnerability score, which was categorised into graded vulnerability levels. Associations between vulnerability, diagnostic severity, and length of hospital stay were explored using descriptive analyses, cross tabulation, and ordinal trend testing. Among 107 patients with valid data, laboratory abnormalities across multiple physiological systems were common. While more than half of the cohort was classified as having low or mild vulnerability, a substantial proportion demonstrated moderate to very high vulnerability. Increasing vulnerability was associated with a progressive shift toward more advanced diagnostic categories and longer hospitalisation. Patients with higher vulnerability levels were disproportionately represented among prolonged hospital stays, and a significant ordinal trend was observed between vulnerability category and length of stay. These findings suggest that laboratory based psychosocial vulnerability reflects cumulative physiological stress that is clinically meaningful during inpatient oncology care. Integrating routine laboratory data into vulnerability assessment may support earlier recognition of patients at risk for complex hospital courses and inform more anticipatory, person-centred supportive care strategies.

Keywords: hospitalisation, laboratory indicators, length of stay, oncology, psychosocial vulnerability, supportive care

1. Introduction

Hospitalisation represents a critical juncture in the illness trajectory of patients with tumour-related conditions. Beyond the immediate biomedical challenges posed by cancer and its treatment, inpatient admission often coincides with heightened psychological distress, functional decline, and disruption of social roles. For many patients, admission signals disease progression, treatment-related complications, or loss of physiological reserve, all of which may intensify experiences of uncertainty, vulnerability, and emotional burden. Within psychosocial oncology, understanding and addressing vulnerability during hospitalisation is therefore central to improving patient-centred care and outcomes [1,2].

Psychosocial vulnerability is traditionally conceptualised as a multidimensional construct encompassing emotional distress, coping capacity, social support, and perceived control [3,4]. In oncology settings, vulnerability is shaped not only by psychological factors but also by the cumulative physiological stress imposed by

disease burden, comorbid conditions, and treatment toxicity [4,5]. However, while psychosocial vulnerability is widely acknowledged as clinically important, its identification in routine inpatient practice remains challenging. Formal psychosocial assessments are often limited by time constraints, patient acuity, and variability in assessment practices, resulting in delayed or inconsistent recognition of patients at risk [6,7].

Routine laboratory testing offers a largely untapped opportunity to capture aspects of patient vulnerability in a systematic and timely manner. Laboratory abnormalities can reflect physiological consequences of malignancy, systemic inflammation, organ dysfunction, and treatment-related stress [8]. Although individual laboratory parameters are commonly interpreted in isolation, their collective pattern may convey a broader narrative of patient burden that intersects with psychosocial wellbeing [9]. Patients presenting with multisystem laboratory abnormalities may experience greater fatigue, reduced functional capacity, heightened symptom distress, and diminished psychological resilience, even in the absence of overt psychiatric symptoms [10,11].

Psychosocial vulnerability in oncology is increasingly conceptualised as a dynamic state arising from the interaction between biological burden, psychological adaptation, and the broader care environment. Recent scholarship has emphasised that mental health outcomes in patients with cancer are shaped not only by diagnosis or treatment exposure, but also by cumulative physiological stress and the quality of supportive interactions encountered during care [12]. Such perspectives highlight the importance of early vulnerability recognition and integrative approaches that extend beyond symptom-specific psychological interventions, particularly during periods of hospitalisation when patients may experience heightened uncertainty and loss of control. These insights underscore the need for pragmatic indicators of vulnerability that are available at admission and capable of informing anticipatory supportive care strategies [13].

Despite this conceptual link, few studies have explored the integration of routine laboratory data into frameworks of psychosocial vulnerability. Existing research in psychosocial oncology has largely focused on patient-reported outcomes, screening instruments for distress, and clinician-assessed needs. While these approaches are essential, they may not fully capture the physiological dimension of vulnerability that influences patients' ability to cope with hospitalization and recovery [14,15]. Moreover, reliance on subjective measures alone may overlook patients who are biologically compromised but less likely to articulate distress, particularly in acute inpatient settings [16].

Length of hospital stay represents a clinically meaningful outcome that reflects both disease severity and care complexity. Prolonged hospitalization is associated with increased symptom burden, functional decline, caregiver strain, and healthcare resource utilization [17]. In oncology populations, longer stays may also indicate complications related to treatment toxicity, organ dysfunction, or advanced disease [18]. Identifying factors associated with extended hospitalization is therefore of practical importance for care planning, discharge coordination, and psychosocial support allocation. However, predictors of length of stay are often examined through disease-specific or procedural lenses, with less attention to integrated measures of patient vulnerability [19].

Against this background, the present study sought to examine whether routinely collected laboratory data could be organised into a composite indicator of psychosocial vulnerability and whether this indicator demonstrated meaningful

associations with diagnostic severity and length of hospital stay among hospitalised patients with tumour-related conditions. Rather than proposing a predictive or causal model, the study adopts an exploratory and construct-oriented approach, aiming to characterise vulnerability as a graded state emerging from cumulative physiological stress [20].

By integrating laboratory parameters across hepatic, renal, urinary, and haematologic domains, this study proposes a pragmatic framework for capturing vulnerability using data that are already embedded within standard inpatient workflows. Such an approach aligns with the principles of person-centred oncology care, where biological, psychological, and social dimensions are recognised as interdependent rather than discrete [21]. Importantly, the use of routine laboratory data avoids additional patient burden and allows vulnerability assessment to occur early during hospitalisation, when timely intervention may be most beneficial [22].

The objectives of this study were therefore threefold. First, to describe the distribution of laboratory based psychosocial vulnerability among hospitalised patients with tumour related conditions. Second, to examine the relationship between vulnerability and diagnostic categories reflecting disease severity and systemic impact. Third, to explore the association between psychosocial vulnerability and length of hospital stay, as an indicator of care complexity and clinical burden. Through these aims, the study seeks to contribute to the growing literature on vulnerability in oncology by demonstrating the relevance of laboratory derived indicators within psychosocial frameworks.

This work does not seek to replace established psychosocial assessment tools, but rather to complement them. By highlighting patterns of vulnerability that are visible through routine clinical data, the study offers a foundation for future research integrating biological markers with patient reported outcomes and psychosocial interventions. Ultimately, advancing such integrative approaches may support more anticipatory, equitable, and compassionate inpatient oncology care

2. Methods

2.1. Study design and setting

This study employed a retrospective observational design to examine laboratory based psychosocial vulnerability among hospitalised patients with tumour related conditions. Data were extracted from routine inpatient medical records at Tongxiang Hospital of Traditional Chinese Medicine located at Tongxiang, Zhejiang, China, a regional tertiary level institution providing integrated oncologic, medical, and supportive care services. The hospital combines conventional biomedical management with traditional Chinese medicine approaches and serves a diverse adult inpatient population.

The analysis focused on laboratory results obtained at or near the time of hospital admission, reflecting patients' physiological status prior to substantial inpatient intervention. By examining admission level laboratory profiles, the study aimed to capture early vulnerability signals present at the onset of hospitalisation rather than changes attributable to treatment during admission.

The primary objective was to characterise the distribution of laboratory derived vulnerability, explore its relationship with diagnostic severity, and examine its association with length of hospital stay. Given the exploratory and construct oriented nature of the study, analyses were descriptive and trend focused rather than predictive.

2.2. Participants and eligibility criteria

Eligible participants included adult patients admitted to Tongxiang Hospital of Traditional Chinese Medicine during the study period with tumour related conditions. These included benign or pre malignant lesions, localised malignant disease, metastatic or advanced malignancy, malignancy accompanied by systemic decline, and selected non oncologic conditions managed within an oncologic clinical context. Inclusion required availability of admission laboratory data sufficient for vulnerability domain classification. Patients were excluded if admission was primarily for short term procedural observation without substantive inpatient management, or if essential laboratory variables required for vulnerability assessment were missing. For variables with partial missing data, analyses were conducted using valid cases only, and missing observations were handled on a variable specific basis.

2.3. Clinical and laboratory data collection

Demographic and clinical variables included age group, sex, diagnostic category, and length of hospital stay. Age was categorised into four groups representing early adulthood, midlife, older adulthood, and advanced age. Diagnostic categories were assigned based on admission diagnoses documented in the medical record and reflected both disease stage and systemic impact.

Length of hospital stay was calculated as the number of days from admission to discharge and categorised into four clinically meaningful groups representing short, intermediate, prolonged, and extended hospitalisation. These categories were selected to reflect increasing care complexity rather than arbitrary statistical cut points.

Laboratory data were obtained from routine admission testing and encompassed hepatic, renal, urinary, and haematologic domains. Hepatic function was assessed using aspartate aminotransferase and alanine aminotransferase levels, renal function using serum creatinine, urinary status using urine protein, glucose, and occult blood, and haematologic status using white blood cell count, haemoglobin, and platelet count. Laboratory values were categorised according to institutional reference ranges and commonly accepted clinical thresholds.

2.4. Construction of laboratory-based vulnerability domains

Laboratory variables were first categorised into clinically interpretable levels representing normal findings and increasing degrees of abnormality. For hepatic enzymes, combined assessment of aspartate aminotransferase and alanine aminotransferase was used to derive a liver stress category reflecting the presence and severity of hepatic enzyme elevation. Renal stress was categorised based on serum creatinine levels, while urinary abnormalities were classified according to the severity of proteinuria, glycosuria, and haematuria. Haematologic abnormalities were categorised using standard thresholds for leukopenia or leukocytosis, anaemia, and thrombocytopenia or thrombocytosis.

Each laboratory domain was considered as a contributor to overall physiological stress. Categories were constructed to prioritise clinical interpretability and to reflect graded vulnerability rather than binary abnormality.

2.5. Psychosocial vulnerability score and categorisation

A composite laboratory based psychosocial vulnerability score was derived by summing domain specific indicators of abnormality across hepatic, renal, urinary, and haematologic systems. Higher scores reflected a greater cumulative burden of laboratory abnormalities across multiple physiological domains. The resulting score was then categorised into five ordered vulnerability levels, ranging from low to very

high vulnerability, to facilitate clinical interpretation and categorical analysis.

Although derived from laboratory data, the vulnerability score was conceptualised as a proxy indicator of broader patient vulnerability, encompassing physiological strain that may influence psychological wellbeing, coping capacity, and care complexity during hospitalisation.

2.6. Statistical analysis

Descriptive statistics were used to summarise patient characteristics, laboratory abnormalities, and vulnerability categories. Categorical variables were presented as frequencies and valid percentages. Laboratory abnormalities were reported by domain, and results were organised to reflect clinically meaningful groupings.

Associations between psychosocial vulnerability and diagnostic category were examined using cross tabulation with row percentages to characterise distribution patterns. The relationship between vulnerability and length of hospital stay was explored using cross tabulation and descriptive trend analyses. Mean vulnerability scores were compared across length of stay categories, and ordered trend testing was conducted using a linear-by-linear association test to assess monotonic relationships between ordinal variables.

Given the exploratory nature of the study and unequal group sizes, emphasis was placed on pattern recognition and trend interpretation rather than formal hypothesis testing. Results from chi square analyses were interpreted with caution when expected cell counts were low. Post hoc comparisons were reported descriptively without claims of statistical significance. All statistical analyses were performed using SPSS software. Statistical significance was defined at a two-sided alpha level of 0.05, with appropriate qualification where assumptions were not fully met.

2.7. Ethical considerations

The study was conducted in accordance with institutional policies governing retrospective analysis of clinical data at Tongxiang Hospital of Traditional Chinese Medicine. Patient identifiers were removed prior to analysis to ensure confidentiality. As the study involved secondary use of routinely collected data and posed minimal risk to participants, the requirement for informed consent was waived in accordance with local ethical guidelines.

3. Results

3.1. Sample characteristics

A total of 107 hospitalised patients with tumour related diagnoses were included in the final analysis. The study population consisted predominantly of middle aged and older adults. Patients aged 60 to 74 years represented the largest age group (36 patients, 33.6%), followed by those aged 45 to 59 years (33 patients, 30.8%). Older patients aged 75 years or above accounted for 19.6% (21 patients), while younger adults aged 18 to 44 years comprised 15.9% (17 patients) of the cohort. Overall, more than half of the patients (53.2%) were aged 60 years or older, reflecting the age profile typically observed among hospitalised oncology populations.

With regard to sex distribution, the cohort was predominantly female, with 66.4% (71 patients) being women and 33.6% (36 patients) being men. At admission, patients presented with a wide range of diagnostic categories, spanning benign or pre-malignant conditions, localised malignant disease, and more advanced clinical states. Nearly half of the cohort was classified as having localised malignant disease (49 patients, 45.8%), while 26.2% (28 patients) were admitted with benign or

pre-malignant conditions. Smaller proportions of patients were hospitalised with metastatic or advanced malignancy (8.4%) or malignancy accompanied by systemic decline (7.5%). In addition, 12.1% of admissions occurred in patients hospitalised for non-oncologic conditions within a tumour related clinical context.

Length of hospital stay varied substantially across the cohort. Short admissions of one to three days were most common (41.1%), whereas 35.5% of patients remained hospitalised for eight days or longer, indicating a notable burden of prolonged inpatient care. A detailed summary of demographic characteristics, diagnostic categories, and length of stay distribution is provided in **Table 1**.

Table 1. Demographic and clinical characteristics of the study population ($n = 107$).

Variable	Category	<i>n</i>	%
Age group (years)	18–44	17	15.9
	45–59	33	30.8
	60–74	36	33.6
	≥ 75	21	19.6
Sex	Male	36	33.6
	Female	71	66.4
Diagnostic group	Benign / pre-malignant	28	26.2
	Localised malignant	49	45.8
	Metastatic / advanced	9	8.4
	Malignancy with systemic decline	8	7.5
	Non-oncologic admission	13	12.1
Length of stay	1–3 days	44	41.1
	4–7 days	25	23.4
	8–14 days	23	21.5
	≥ 15 days	15	14.0

3.2. Laboratory abnormalities

3.2.1. Hepatic and renal function

Abnormalities in hepatic enzymes were highly prevalent in the study population. Based on combined assessment of aspartate aminotransferase and alanine aminotransferase, all patients with valid liver enzyme data demonstrated some degree of liver stress. Among the 107 patients with available results, 62.6% (67 patients) were classified as having mild liver stress, while 37.4% (40 patients) exhibited moderate liver stress. No patients met criteria for absence of liver stress under the combined enzyme classification. A small proportion of liver enzyme data (2.7%) was missing and excluded from analyses. The distribution of hepatic and renal stress categories is detailed in **Table 2**.

Table 2. Hepatic and renal laboratory abnormalities ($n = 107$).

Laboratory domain	Category	<i>n</i>	%
Liver stress	Mild liver stress	67	62.6
	Moderate liver stress	40	37.4
Renal stress	No renal stress	65	60.7
	Mild renal stress	12	11.2
	Moderate renal stress	30	28.0

Note: Percentages (%) are calculated using valid data. Liver stress was derived from combined aspartate aminotransferase (AST) and alanine aminotransferase (ALT) categories. A small proportion of data (2.7%) was missing and excluded from analyses.

Renal involvement was also common. While 60.7% (65 patients) showed no laboratory evidence of renal stress, 11.2% (12 patients) demonstrated mild renal stress, and 28.0% (30 patients) exhibited moderate renal stress based on serum creatinine derived categorisation. Overall, 39.3% of patients presented with some degree of renal stress at admission, indicating frequent renal vulnerability in this tumour related inpatient population.

3.2.2. Urinary abnormalities

Urinary abnormalities were frequently identified among patients with available urinalysis data. With respect to urine protein, 51.4% (55 patients) had negative findings, while 48.6% demonstrated proteinuria of varying severity, including trace (12.1%), mild (11.2%), moderate (16.8%), and severe (8.4%) proteinuria.

Urine glucose abnormalities were less common. The majority of patients (90.7%) had negative urine glucose results, whereas 9.3% exhibited glycosuria ranging from trace to severe levels.

Urinary occult blood was detected in a substantial subset of patients. Among those with valid data, 31.8% demonstrated haematuria, most frequently at the trace level (24.3%), with smaller proportions showing mild, moderate, or severe abnormalities. Across urinary parameters, 2.7% of data were missing and excluded from domain specific analyses. Detailed distributions of urinary findings are presented in **Table 3**.

Table 3. Urinary laboratory abnormalities ($n = 107$).

Urinary parameter	Category	<i>n</i>	%
Urine protein	Negative	55	51.4
	Trace	13	12.1
	Mild	12	11.2
	Moderate	18	16.8
	Severe	9	8.4
Urine glucose	Negative	97	90.7
	Trace	3	2.8
	Mild	2	1.9

Continuation Table:

Urinary parameter	Category	<i>n</i>	%
Urine occult blood	Moderate	4	3.7
	Severe	1	0.9
	Negative	73	68.2
	Trace	26	24.3
	Mild	4	3.7
	Moderate	2	1.9
	Severe	2	1.9

Note: Percentages (%) are based on valid urinalysis results. Missing data accounted for 2.7% of observations and were excluded from analyses.

3.2.3. Haematologic abnormalities

Haematologic disturbances were also observed across the cohort. With respect to white blood cell count, 71.0% (76 patients) had values within the normal range, while 1.9% (2 patients) exhibited leukopenia and 27.1% (29 patients) demonstrated elevated counts, indicating a notable prevalence of inflammatory or stress related haematologic responses.

Anaemia was common in this hospitalised tumour related population. Among patients with valid haemoglobin data, 40.2% (43 patients) had low haemoglobin levels, while 59.8% (64 patients) were within the normal range.

Platelet abnormalities were less frequent. The majority of patients (84.1%) had platelet counts within the normal range. Thrombocytopenia was observed in 2.8% (3 patients), whereas thrombocytosis occurred in 13.1% (14 patients). As with other haematologic variables, 2.7% of data were missing and excluded from analyses. A summary of haematologic laboratory findings is provided in **Table 4**.

Table 4. Haematologic laboratory abnormalities (*n* = 107).

Haematologic parameter	Category	<i>n</i>	%
White blood cell count	Low	2	1.9
	Normal	76	71.0
	High	29	27.1
Haemoglobin	Low	43	40.2
	Normal	64	59.8
Platelet count	Thrombocytopenia	3	2.8
	Normal	90	84.1
	Thrombocytosis	14	13.1

Note: Percentages (%) are calculated using valid data. Haematologic parameters reflect admission laboratory findings.

3.3. Psychosocial vulnerability categories

3.3.1. Distribution of psychosocial vulnerability levels

Based on the composite laboratory based psychosocial vulnerability score, patients were distributed across a broad range of vulnerability levels. Among the 107 patients with valid vulnerability data, the largest proportion was classified as having low vulnerability (41.1%, 44 patients). An additional 15.9% (17 patients) were categorised as having mild vulnerability, resulting in 57.0% of the cohort being classified within the lower vulnerability range.

Higher levels of vulnerability were also frequently observed. Moderate vulnerability was identified in 25.2% (27 patients), while high vulnerability was present in 5.6% (6 patients). A further 12.1% (13 patients) were classified as having very high vulnerability, reflecting substantial cumulative laboratory abnormalities across multiple physiological domains. Overall, 42.9% of patients demonstrated moderate to very high vulnerability, indicating that a considerable proportion of hospitalised patients with tumour related conditions experienced pronounced physiological stress. A small proportion of vulnerability data (2.7%) was missing and excluded from analyses. The distribution of vulnerability categories is summarised in **Table 5**.

Table 5. Distribution of psychosocial vulnerability categories ($n = 107$).

Vulnerability category	<i>n</i>	%
Low vulnerability	44	41.1
Mild vulnerability	17	15.9
Moderate vulnerability	27	25.2
High vulnerability	6	5.6
Very high vulnerability	13	12.1

Note: Percentages (%) are calculated using valid data. Vulnerability categories were derived from a composite laboratory-based score integrating hepatic, renal, urinary, and haematologic domains.

3.3.2. Diagnostic distribution across vulnerability categories

The composition of diagnostic groups varied markedly across psychosocial vulnerability categories. Patients classified as having low vulnerability were predominantly admitted with benign or pre-malignant conditions, accounting for 59.1% of this group, followed by localised malignant disease (25.0%). No patients with low vulnerability were observed in the metastatic or advanced diagnostic category.

Among patients with mild vulnerability, admissions were dominated by localised malignant disease (76.5%), with smaller proportions admitted for benign or non-oncologic conditions. Patients with moderate vulnerability demonstrated a broader diagnostic profile, with 66.7% admitted for localised malignant disease, 22.2% for metastatic or advanced malignancy, and 7.4% for malignancy accompanied by systemic decline.

In the high vulnerability group, half of the patients (50.0%) were diagnosed with localised malignant disease, while 16.7% were admitted with metastatic or advanced malignancy and 33.3% with non-oncologic conditions in a tumour related clinical

context. Patients classified as having very high vulnerability exhibited the most clinically complex diagnostic patterns. Over one third (38.5%) were admitted with malignancy accompanied by systemic decline, while 30.8% had localised malignant disease and 15.4% had metastatic or advanced malignancy. No patients with very high vulnerability were classified within the benign or pre-malignant diagnostic group.

Taken together, these findings demonstrate a progressive shift in diagnostic severity across increasing psychosocial vulnerability categories, from benign or early-stage disease toward advanced malignancy and systemic decline. The detailed cross tabulation of diagnostic groups by vulnerability category is presented in **Table 6**, and the proportional distribution across categories is visually illustrated in **Figure 1**.

Table 6. Diagnostic group distribution across psychosocial vulnerability categories ($n = 107$).

Vulnerability category	Benign or pre-malignant	Localised malignant	Metastatic or advanced	Malignancy with systemic decline	Non-oncologic
Low	59.1%	25.0%	0.0%	2.3%	13.6%
Mild	11.8%	76.5%	0.0%	0.0%	11.8%
Moderate	0.0%	66.7%	22.2%	7.4%	3.7%
High	0.0%	50.0%	16.7%	0.0%	33.3%
Very high	0.0%	30.8%	15.4%	38.5%	15.4%

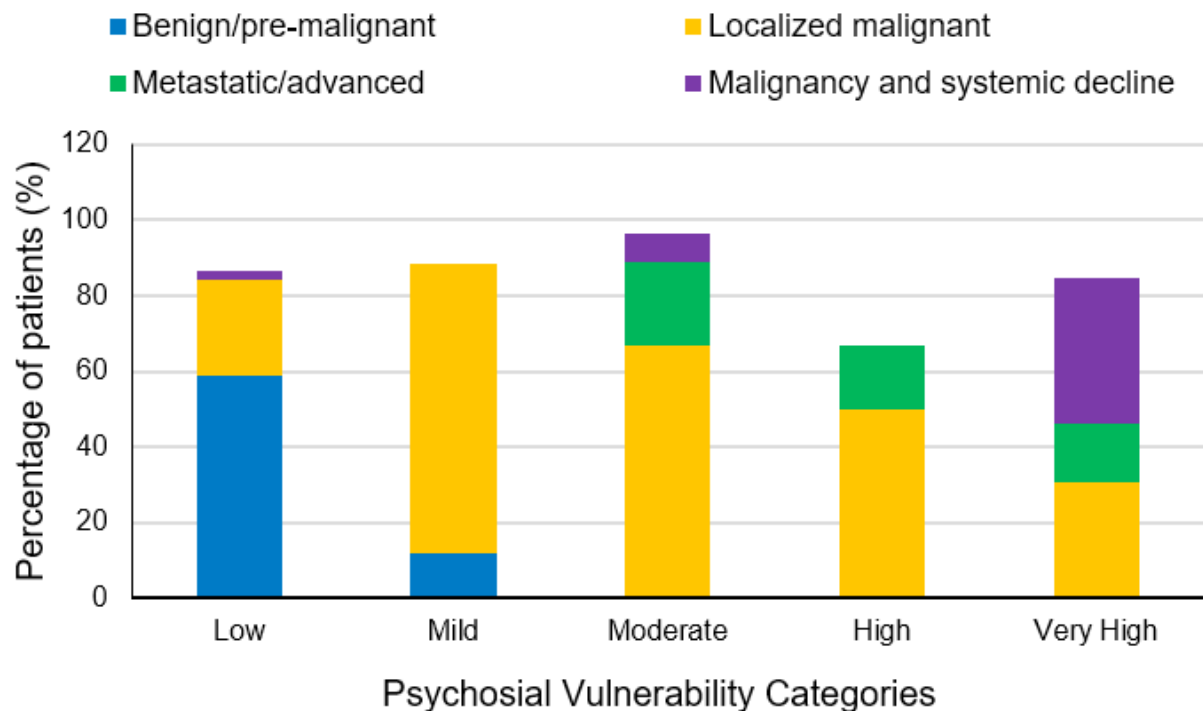


Figure 1. Diagnostic group distribution across psychosocial vulnerability categories.

3.4. Association between psychosocial vulnerability and length of stay

Length of hospital stay varied markedly across psychosocial vulnerability categories. Among patients classified as having low vulnerability, the majority experienced short hospitalisations, with 61.4% discharged within 1 to 3 days, and no patients in this group remaining hospitalised for more than 15 days. Similarly, patients

with mild vulnerability predominantly had shorter stays, with 47.1% admitted for 1 to 3 days and none exceeding 15 days of hospitalisation.

In contrast, patients with higher vulnerability demonstrated progressively longer lengths of stay. Among those with moderate vulnerability, only 25.9% were discharged within 1 to 3 days, while 33.3% remained hospitalised for more than 15 days. Patients classified as having high vulnerability showed a more even distribution across longer stay categories, with 33.3% remaining hospitalised for more than 15 days, and none discharged within the first 3 days.

Patients with very high vulnerability exhibited the most prolonged hospitalisations. Only 15.4% were discharged within 1 to 3 days, whereas 30.8% remained hospitalised for 8 to 14 days, and an additional 30.8% for more than 15 days. Overall, the proportion of patients experiencing extended hospital stays increased steadily with rising psychosocial vulnerability.

These findings indicate a clear gradient between psychosocial vulnerability and length of stay, with higher vulnerability categories associated with longer and more complex hospitalisations. The distribution of length of stay across vulnerability categories is summarised in **Table 7**.

Table 7. Length of stay distribution across psychosocial vulnerability categories ($n = 107$).

Vulnerability category	1–3 days	4–7 days	8–14 days	> 15 days
Low	61.4	22.7	15.9	0.0
Mild	47.1	41.2	11.8	0.0
Moderate	25.9	11.1	29.6	33.3
High	0.0	33.3	33.3	33.3
Very high	15.4	23.1	30.8	30.8

4. Discussion

This study examined the distribution and clinical relevance of a composite laboratory based psychosocial vulnerability index among hospitalised patients with tumour related conditions. By integrating routinely available laboratory parameters across hepatic, renal, urinary, and haematologic domains, the analysis sought to capture a dimension of patient vulnerability that is often implicitly recognised in clinical practice but rarely formalised or examined systematically. The findings demonstrate that laboratory derived vulnerability is common, heterogeneous, and meaningfully associated with diagnostic severity and length of hospital stay, supporting the clinical relevance of this construct within inpatient oncology settings.

A central finding of the present study is the high prevalence of laboratory abnormalities across multiple physiological systems at the time of hospital admission. Hepatic enzyme disturbances were nearly universal, renal stress affected a substantial proportion of patients, and urinary and haematologic abnormalities were frequently observed. These findings underscore the extent to which patients hospitalised with tumour related conditions present with complex physiological burden that extends beyond the primary oncologic diagnosis. From a psychosocial oncology perspective, such multisystem stress is likely to shape patient's lived experiences of illness, including fatigue, uncertainty, perceived loss of bodily control, and emotional distress [23]. The laboratory-based vulnerability index thus offers a clinically

grounded proxy for this broader burden, bridging objective physiological data with subjective psychosocial impact [24,25].

The distribution of psychosocial vulnerability levels revealed that while a majority of patients fell within the low to mild vulnerability range, a substantial proportion demonstrated moderate to very high vulnerability. Notably, more than two in five patients exhibited vulnerability scores reflecting cumulative abnormalities across several laboratory domains. This heterogeneity is clinically important. It suggests that vulnerability is not an inevitable consequence of hospitalisation or cancer diagnosis per se, but rather a graded state influenced by the interaction of disease characteristics, physiological reserve, and systemic stress [26–28]. Recognising this variability challenges one size fits all approaches to inpatient oncology care and highlights the need for early identification of patients at heightened risk for adverse trajectories [29,30].

The observed relationship between psychosocial vulnerability and diagnostic category provides further evidence of construct validity. Patients with low vulnerability were predominantly admitted with benign or pre-malignant conditions or localised malignancy, whereas increasing vulnerability was associated with a progressive shift toward advanced disease states and systemic decline. Importantly, this pattern was not absolute. Even among patients with localized malignant disease, a wide range of vulnerability levels was observed, indicating that tumour stage alone does not fully account for physiological and psychosocial burden. This finding reinforces the notion that vulnerability is a multidimensional construct that captures aspects of patient status not fully reflected by traditional diagnostic classifications [31,32].

The association between psychosocial vulnerability and length of hospital stay represents one of the most clinically salient findings of the study. Both categorical and trend-based analyses demonstrated a clear gradient, with higher vulnerability levels corresponding to progressively longer hospitalisations. Patients with low or mild vulnerability were predominantly discharged within a few days, whereas those with moderate, high, or very high vulnerability were increasingly represented among prolonged admissions. This pattern persisted across analytical approaches and was supported by a significant linear trend, despite limited power for pairwise comparisons [33]. From a systems perspective, these findings suggest that laboratory-based vulnerability may serve as an early indicator of care complexity, resource utilisation, and discharge challenges [34–36].

Beyond its operational implications, the relationship between vulnerability and length of stay carries important humanistic meaning. Prolonged hospitalisation is not merely a marker of disease severity; it is also a period characterised by disruption of daily life, separation from social support, heightened uncertainty, and emotional strain. Patients with higher vulnerability scores may therefore be experiencing not only greater physiological stress but also more profound psychosocial challenges during admission. The vulnerability index, though derived from laboratory data, may thus help identify patients who would benefit from earlier psychosocial support, enhanced communication, and interdisciplinary care planning [37,38].

The findings also invite reflection on the role of routine laboratory testing in psychosocial oncology. Laboratory results are often viewed narrowly as tools for diagnosis or monitoring treatment toxicity. However, when considered collectively, they may convey a broader narrative of patient vulnerability that is immediately available at the bedside [39]. Formalizing this information into a composite index

has the potential to enhance situational awareness among clinicians, supporting more holistic assessments that integrate biological, functional, and psychosocial dimensions of care. While a direct reference to the enhancement of situational awareness in psychosocial oncology is not evident in the references provided, the underlying principle that composite metrics can provide a better understanding of patient status is supported by the literature on frailty assessments and patient outcomes [40,41]. Importantly, such an approach does not require additional testing or patient burden, making it particularly suitable for busy inpatient settings [42].

Several limitations should be considered when interpreting the results. The study was conducted in a single centre with a modest sample size, and some diagnostic and length of stay categories contained small numbers of patients. As a result, certain statistical comparisons lacked power, and findings should be interpreted as exploratory rather than definitive [43]. The vulnerability index was constructed using available laboratory domains and did not incorporate direct measures of psychological distress, functional status, or social support, which are central components of psychosocial vulnerability [44]. Future studies should examine how laboratory-based vulnerability aligns with patient-reported outcomes and clinician-assessed psychosocial needs [45].

Despite these limitations, the present study offers a novel contribution by demonstrating that routinely collected laboratory data can be meaningfully organised to reflect graded vulnerability with clear clinical correlates. The consistency of associations across diagnostic severity and length of stay supports the relevance of this approach and suggests potential avenues for future research and clinical application. Prospective validation in larger and more diverse populations, integration with psychosocial screening tools, and evaluation of its role in guiding supportive care interventions represent important next steps.

This study highlights psychosocial vulnerability as a measurable and clinically relevant construct that emerges at the intersection of physiological burden and illness context. By leveraging routine laboratory data, the proposed vulnerability index provides a pragmatic framework for identifying patients at risk for prolonged hospitalisation and complex care needs. Incorporating such insights into inpatient oncology practice may support timelier, person centred, and anticipatory approaches to care, aligning clinical decision making with the holistic needs of patients navigating serious illness.

5. Conclusion

This study demonstrates that psychosocial vulnerability, operationalised through routinely collected laboratory indicators, is prevalent among hospitalised patients with tumour related conditions and exhibits meaningful associations with diagnostic severity and length of hospital stay. By integrating laboratory abnormalities across hepatic, renal, urinary, and haematologic domains, the proposed vulnerability framework captures cumulative physiological stress that reflects broader patient burden during hospitalisation. The graded relationship observed between vulnerability levels, disease complexity, and prolonged hospitalisation underscores the clinical relevance of this construct within inpatient oncology settings. Although exploratory in nature, these findings suggest that laboratory-based vulnerability assessment may complement existing psychosocial screening approaches by providing an early, pragmatic indicator of patients at risk for complex care trajectories. Incorporating such insights into routine inpatient practice has the potential to support more anticipatory, person-centred supportive care and to inform future research integrating

biological markers with psychosocial outcomes in oncology.

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Informed consent statement: Informed consent was obtained from all subjects involved in the study.

Conflict of interest: The authors declare no conflict of interest.

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