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The financial impact of colorectal cancer and its consequences: associations between cancer-related financial stress and strain and health-related quality-of-life

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Category: colorectal/anal neoplasia

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ABSTRACT

Background: The financial impact of cancer on survivors' lives, and its consequences, remain poorly understood. This is especially true for colorectal cancer.

Objective: We investigated objective cancer-related financial stress, subjective cancer-related financial strain and their association with health-related quality-of-life in colorectal cancer survivors.

Design: Cross-sectional postal survey

Setting: Ireland, which has a mixed public-private healthcare system

Patients: Colorectal cancer survivors, diagnosed 6-37 months previously, were identified from the population-based National Cancer Registry.

Main Outcome Measures: Cancer-related financial stress was assessed as impact of cancer on household ability to make ends meet; and cancer-related financial strain by feelings about household financial situation since cancer diagnosis. Health-related quality-of-life was based on European Organisation for Research and Treatment of Cancer QLQ-C30 global health status. Logistic regression was used to identify associations between financial stress and strain and low health-related quality-of-life (lowest quartile, score ≤ 50).

Results: 493 survivors participated. Overall, 41% reported cancer-related financial stress and 39% cancer-related financial strain; 32% reported both financial stress and financial strain. After adjustment for socio-demographic and clinical variables, the odds of low health-related quality-of-life were significantly higher in those who reported cancer-related financial stress post-diagnosis compared to those who reported no change in financial stress post-cancer (odds ratio=2.54, 95% confidence interval 1.62-3.99). The odds of low health-related quality-of-life were also significantly higher in those with worse financial strain post-diagnosis (1.73, 1.09-2.72). The odds ratio for those with both cancer-related financial stress and financial strain was 2.59 (1.59-4.22).

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Limitations: Survey responders were younger, on average, than non-responders. Responders and non-responders may have differed in cancer-related financial stress and strain or health-related quality-of-life.

Conclusions: Four in ten colorectal cancer survivors reported an adverse financial impact of cancer. Cancer-related financial stress and strain were significantly associated with low health-related quality-of-life. To inform support strategies, further research is needed to better understand how both objective and subjective financial distress influence survivors' health-related quality-of-life.

INTRODUCTION

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2 Population ageing and rising survival mean that more people are living with colorectal cancer. In
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4 developed countries, substantial health service-related costs are associated with diagnosis,
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6 treatment and follow-up of colorectal cancer.^{1,2} Increasingly, however, there is recognition that
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8 additional perspectives on the economic burden of merit consideration, including that of those living
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10 with the cancer.
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16 Colorectal cancer patients may incur cancer-related out-of-pocket expenses (e.g. for medical visits or
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18 treatment)³⁻⁶ and/or loss of income due to cancer-related work absence,^{7,8} and these have the
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20 potential to lead to cancer-related financial hardship. Although the literature on financial hardship
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22 among cancer survivors is growing,⁹⁻¹⁴ it has significant limitations. Few studies are specific to
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24 colorectal cancer, most come from a few mainly public or mainly private healthcare systems, and
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26 very few specify whether the hardship is a result of the cancer diagnosis or simply reflects pre-
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28 existing financial difficulties. One study which did focus on the financial impact of the cancer found
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30 that 38% of colon cancer patients in the US experienced one or more financial hardships resulting
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32 from treatment.¹⁵
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40 A further limitation relates to measurement of cancer-related financial hardship. In assessing the
41
42 financial impact of illness, both objective and subjective measures of impact should be
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44 considered.^{16,17} An objective measure assesses the impact of financial stressors experienced by the
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46 household, such as additional costs, while a subjective measure characterises how an individual
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48 perceives the financial impact. No colorectal cancer studies (and very few studies of other cancers)
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50 have considered these two dimensions of cancer-related financial impact.
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56 Moreover, the wider consequences of cancer-related financial difficulties on colorectal cancer
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58 survivors' lives are underreported. Studies in other cancers have indicated that patients who
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1 experience financial hardship, difficulties or distress may have poorer psychological wellbeing,
2 general wellbeing or health-related quality-of-life (HRQoL)¹⁸⁻²¹ but there has been little similar work
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4 in colorectal cancer.^{14,22,23}
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9 This study aimed to investigate – for the first time - associations between objective cancer-related
10 financial stress and subjective cancer-related financial strain and HRQoL in colorectal cancer
11 survivors, in a country with a mixed public-private healthcare system.
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17 **METHODS**

18 ***Setting***

19 The study setting was Ireland, which has a complex mixed public-private healthcare system.²⁴ All
20 residents are entitled to care within the public system. Cancer care within the public system has
21 been largely centralised. For colorectal cancer treatment, there are eight designated cancer centres
22 and 85-90% of those who undergo surgery are treated in public hospitals. Unless an individual holds
23 a medical card (eligibility for which is based on financial means and age), they must make modest co-
24 payments for visits to doctors or overnight stays in public hospitals (e.g. approximately €60 to visit a
25 GP) and pay full cost of prescription medications. Approximately half of the population holds private
26 health insurance which, in the main, covers hospital in-patient stays either in a private hospital or as
27 a private patient in a within a public hospital; costs of GP visits, and prescriptions medications, are
28 not usually covered. Individuals may join the Drug Payment Scheme which applies a ceiling - €120
29 per month - to the amount that they have to pay for prescription drugs and certain aids (including
30 ostomy appliances).
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53 ***Participants***

54 In January 2010, survivors of primary, invasive colorectal cancer (ICD10 C18-C20) were identified
55 through the National Cancer Registry (NCR). Cancer registration is population-based and
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1 completeness is estimated to be in excess of 97%. Survivors had to be diagnosed between October
2 2007 and September 2009, believed to be still alive and treated at one of 38 hospitals. Treating
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4 clinicians were asked to confirm whether each individual was (i) aware they had cancer; (ii) able to
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6 understand English; and (iii) well enough to participate (in particular, cognitively able to give
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8 informed consent). Those who were not eligible on this basis, or whose clinician did not respond,
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10 were excluded. A questionnaire was sent by post to 1,273 eligible individuals; survivors were
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12 between 6 and 37 months from diagnosis at the time they received the questionnaire. Non-
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14 responders were sent up to two reminders at fortnightly intervals.
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21 The study was approved by the research ethics committees of the hospitals at which the survivors
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23 had been treated. Participants provided written informed consent.
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28 ***Questionnaire and other data***

29 *Health-related quality-of-life*

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31 The questionnaire included the European Organisation for Research and Treatment of Cancer
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33 (EORTC) QLQ-C30, which has been developed and validated to assess different aspects of HRQoL in
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35 patients with a range of cancers from different countries.^{25,26} The final two questions, which ask
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37 respondents to rate their health and quality-of-life over the past week on a scale of 1 (very poor) to
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39 7 (excellent), constitute the global health score which can be interpreted as a measure of overall
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41 HRQoL. The questions were scored as recommended to generate a single value in the range from 0
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43 (poorest HRQoL) to 100 (best HRQoL).
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52 *Cancer-related financial stress and strain*

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54 Following Francoeur¹⁶ and previous work on financial hardship among cancer survivors in Ireland,^{20,27}
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56 the questionnaire included one objective and one subjective measure of cancer-related financial
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58 impact – the former termed cancer-related financial stress and the latter cancer-related financial
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1 strain. Cancer-related financial stress was assessed as the impact of the cancer diagnosis on the
2 household's ability to make ends meet, and cancer-related financial strain as the impact on the
3 individual (i.e. how the respondent had felt about their household's financial situation since their
4 cancer diagnosis). Response options for these questions were 7-level Likert-type scales ranging from
5 "much more difficult"/"very concerned" to "much less difficult"/"much less concerned". These were
6 collapsed for analysis into three groups: more difficult/concerned, no change, and less
7 difficult/concerned. Those who fell into the categories more difficult or more concerned were
8 considered to experience cancer-related financial stress or strain, respectively. For analysis, a third
9 variable (cancer-related financial impact) was created based on the combination of responses to the
10 financial stress and strain questions. This had three categories: both stress and strain, either stress
11 or strain (but not both) and neither stress nor strain.
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28 *Potential confounding variables*

29 Demographic, socio-economic and clinical variables are associated with HRQoL in colorectal
30 cancer.²⁸⁻³⁰ The clinical variables available from the Registry were: site, stage at diagnosis,
31 treatments received (cancer-directed surgery, chemotherapy, radiotherapy, and number of
32 treatments) within a year of diagnosis and time since diagnosis. Presence of a stoma was self-
33 reported on the questionnaire. Demographic variables from the questionnaire were: age at
34 questionnaire completion; marital status; whether the individual lived with others or alone;
35 nationality; sex; and whether the individual had children. Socio-economic variables derived from the
36 questionnaire were: highest level of education completed, employment status at the time of
37 diagnosis, and the identity of the main earner in the household.
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54 *Statistical Analysis*

55 Socio-demographic and clinical characteristics of responders and non-responders were compared
56 using chi-square tests. Mean HRQoL scores were compared between cancer-related financial stress,
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1 strain and impact groups using analysis of variance and the magnitude of the differences assessed
2 for clinical significance; following Osoba et al.³¹ differences of 5–9.9, 10–19.9 and ≥20 points were
3 considered ‘minimally’, ‘moderately’ and ‘largely’ clinically significant, respectively. Regression
4 models were developed to test associations between cancer-related stress and strain and HRQoL.
5 Since the key assumptions underlying linear regression were violated, HRQoL was collapsed into a
6 binomial outcome allowing use of logistic regression. Since there is no pre-defined cut-off for low
7 HRQoL, this was defined *a priori* as the 25% of individuals with the lowest HRQoL scores. To build a
8 multivariable model, relationships between each demographic, socio-economic and clinical variable
9 and HRQoL were evaluated. Variables which were significant ($p<0.05$) were fitted simultaneously
10 and those which remained significant at this level (and which were not collinear with other variables)
11 were retained in the model. Cancer-related financial stress, cancer-related financial strain, and
12 cancer-related financial impact were added (separately) to this model. The final models had
13 adequate fit. In sensitivity analyses, the final models were re-run using multiple linear regression. All
14 analyses were conducted in Stata 14.0.

35 RESULTS

37 *Respondents’ characteristics and HRQoL*

38 In total, 496 survivors returned questionnaires; responses from three individuals were very
39 incomplete so they were excluded, leaving 493 for analysis (response rate 39%). Responders and
40 non-responders did not differ significantly in terms of sex; cancer site; receipt of surgery,
41 chemotherapy or radiotherapy; stage at diagnosis; or time since diagnosis. They did differ by age
42 ($p<0.01$); non-responders were, on average, slightly older than responders.

43 Demographic, socio-economic and clinical characteristics of responders are shown in Table 1. Men
44 accounted for 63% of respondents; almost 40% were aged under 65, 33% were 65-74 and 28% were
45 75 and older; 38% were within a year of diagnosis, 48% were 1-2 years and 15% were ≥2 years from

1 diagnosis; 62% had colon cancer; 86% had had cancer-directed surgery; 28% had had chemotherapy;
2 16% had had radiotherapy; and 22% currently had a stoma.
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7 474 respondents provided information on HRQoL. The mean score was 69.8 (sd 21.6); the median
8 was 66.7 (inter-quartile range 50.0-83.3).
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10 11 12 13 ***Cancer-related financial stress, strain and impact*** 14

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16 464 respondents completed the cancer-related financial stress question. Of these, 41.0% had
17 cancer-related financial stress (i.e. they reported that cancer had made it more difficult for their
18 household to make ends meet); 56.7% reported no change; and 2.4% reported that cancer had
19 made it less difficult to make ends meet (Figure 1).
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28 Information about cancer-related financial strain was provided by 467 respondents. 39.4% had
29 cancer-related financial strain (i.e. they were more concerned about their household's financial
30 situation since their cancer diagnosis); 48.4% reported no change; and 12.2% reported that they
31 were less concerned (Figure 1).
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40 Of the 461 respondents who answered both questions, 32.1% reported both financial stress and
41 strain, 16.7% reported either financial stress or strain, and 51.2% reported neither financial stress
42 nor strain.
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47 48 49 ***Demographic, socio-economic and clinical variables and low HRQoL*** 50

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52 Associations between individual demographic, socio-economic and clinical variables and low HRQoL
53 are shown in Supplementary Table 1. Receipt of chemotherapy, presence of a stoma, having
54 children and educational level remained in the multivariate model (Table 2). The odds of low HRQoL
55 were 40% lower in those who had had chemotherapy (adjusted OR=0.59, 95%CI 0.36-0.98)
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1 compared to those who had not, and were 80% higher in those who currently had a stoma (OR=1.80,
2 95% CI 1.11-2.92) compared to those who did not. Compared to those with a secondary level
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4 education, those who had completed only primary education had almost two-fold raised odds of low
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6 HRQoL (OR=1.97, 95%CI 1.21-3.19). Having children was also associated with two-fold raised odds
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8 (OR=2.18, 95%CI 1.24-3.83).
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14 ***Mean HRQoL by cancer-related financial stress, strain and impact***

16 Mean HRQoL scores varied significantly by cancer-related financial stress, strain and impact
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18 (Supplemental Table 2; all $p < 0.001$). The mean HRQoL among those who reported cancer-related
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20 financial stress was 12.9 points lower than among those who reported no change, a moderately
21
22 clinically significant difference. The difference in mean HRQoL between those reporting financial
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24 strain versus no change (9.2 points) was minimally clinically significant. Those who reported both
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26 cancer-related financial stress and strain had a moderately clinically significantly higher mean HRQoL
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28 than those who reported neither stress nor strain (difference 13.6 points).
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35 ***Cancer-related financial stress, strain, and impact and low HRQoL***

37 38% of those who reported cancer-related financial stress had low HRQoL, compared to 19% who
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39 stated that cancer had had no impact on their household's financial situation, and 10% who reported
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41 that their household's financial situation was less difficult since diagnosis (chi-square $p < 0.001$);
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43 unadjusted ORs are shown in Supplementary Table 1. After adjusting for educational level, children,
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45 current stoma and chemotherapy, there was a significant association between cancer-related
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47 financial stress and low HRQoL (likelihood ratio test (LRT) $p < 0.001$). The odds of low HRQoL were
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49 significantly higher in those with cancer-related financial stress compared to those reporting no
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51 change (OR=2.54, 95%CI 1.62-2.3.99)(Table 3).
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Low HRQoL was present in 34% of those reporting cancer-related financial stress, compared to 23% of those who stated that their feeling about their household's financial situation had not changed, and 14% of those who indicated that they were less concerned (chi-square $p=0.003$). ORs are shown in Supplementary Table 1. After adjustment, there was a significant association between cancer-related financial strain and low HRQoL (LRT $p=0.009$). Compared to those reporting no change, the odds of low HRQoL were 1.73 times higher (95%CI 1.09-2.72) in those who experienced cancer-related financial strain (Table 3).

Compared to those with neither cancer-related financial stress nor strain, the multivariable ORs were 1.39 (95%CI 0.73-2.65) for those with either stress or strain and 2.59 (95%CI 1.59-4.99) for those with both (Table 3).

Sensitivity analysis

In the sensitivity analysis using linear regression, all three financial hardship variables were significantly associated with HRQoL after adjusting for socio-demographic and clinical variables; patterns of association were very similar to those from logistic regression (Supplementary Table 3).

DISCUSSION

Prevalence of cancer-related financial hardship

In this study, four in every 10 colorectal cancer survivors reported experiencing either cancer-related financial stress or cancer-related financial strain, and one-third experienced both. It is difficult to compare levels, or prevalence, of cancer-related financial difficulties between studies because authors have used very different questions⁹ which probably measure somewhat different constructs. Despite this, it was noteworthy that prevalence of cancer-related financial impact in our study was similar to prevalence of cancer-related financial hardships in a US study of colon cancer survivors,¹⁵ particularly given that cancer patients in Ireland are entitled to care within the public healthcare

1 system and, while most patients incur some cancer-related out-of-pocket costs, for the majority
2 these are relatively modest.⁶ This suggests that cancer can have a significant financial impact on
3 colorectal cancer patients in different healthcare systems (and even where there is public provision)
4 and provides further evidence to suggest that financial protections in health are inadequate.³²
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11 Compared to a study breast and prostate cancer survivors in Ireland, which used the same financial
12 impact questions, the prevalence of cancer-related financial stress in the current study was lower
13 (41% vs 48%) and the prevalence of financial strain was higher (39% vs 32%).²⁷ In the breast and
14 prostate cancer study, employment status at diagnosis was an important predictor of financial
15 impact, with risk highest in the group who were working at diagnosis; this was most likely explained
16 by income “shock” i.e. loss of income as a result of time away from work due to cancer. In the
17 current study, the percentage reporting cancer-related financial stress was higher among colorectal
18 cancer survivors working at diagnosis than other groups (employed/self-employed 58%; retired 29%,
19 other 32%) but the proportion of colorectal cancer survivors in paid work at diagnosis was lower
20 than among breast and prostate cancer survivors.^{33,34} This could account for the lower prevalence of
21 cancer-related financial stress in colorectal survivors.
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40 The higher prevalence of financial strain is more difficult to explain. Some colorectal cancer survivors
41 experience ongoing cancer-related costs (e.g. stoma bags, clothes, dietary supplements) and it could
42 be that these recurring costs (albeit modest) serve to remind survivors of financial outlays and
43 stimulate financial concerns. Notably, 50% of those with a stoma at the time of the survey reported
44 cancer-related financial strain compared to 36% of those without a stoma.
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54 In terms of other drivers of cancer-related financial hardship in this population, in *post hoc* analyses
55 we found no association with out-of-pocket costs. However, as we have noted elsewhere,⁶ the
56 magnitude of out-of-pocket costs is partly a function of ability to pay (i.e. those with higher costs are
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1 often those most able to meet these costs). Both private health insurance and access to medical
2 cards appear to provide some protection against cancer-related financial hardship. The prevalence
3 of financial stress was higher in those without private health insurance (46% vs 37%) and the
4 prevalence of both stress and strain was higher in those without a medical card at diagnosis (stress:
5 47% vs 36%; strain 47% vs 32%), although the high frequency of stress and strain in those without
6 these financial protections indicated that other factors are involved. Beyond this study, although
7 recognition is growing that cancer can cause financial hardship/difficulties/impact,^{10,35-36} relatively
8 little is known about the prevalence or what predisposes cancer survivors to them, especially for
9 specific cancers and outside the US. The current study extends the evidence-base, but further
10 research in these areas is urgently required. In particular, it would be useful to better understand
11 drivers of - and buffers against – cancer-related financial hardship in settings like Ireland where
12 publicly-funded healthcare is available.

30 ***Cancer-related financial stress and strain and HRQoL***

31 Cancer-related financial stress and strain, and the combination of these, were associated with low
32 HRQoL after adjusting for socio-demographic and clinical factors. Moreover, the difference in mean
33 HRQoL scores between those who reported cancer-related financial stress or strain and those who
34 did not attained clinical significance.

35 Studies in other cancers have reported associations between financial burden and poorer
36 psychological wellbeing.^{18,20} From qualitative research, we have previously postulated inter-play
37 between the financial and emotional impacts of colorectal cancer such that financial distress may
38 exacerbate emotional distress.³⁷ This is compatible with research in the population which indicates
39 that poverty imposes a cognitive load and consumes mental resources.³⁸ Others have reported
40 associations between poorer psychological wellbeing and lower HRQoL in colorectal cancer.³⁹ This
41 suggests that our findings could be indirectly due to the financial impact adversely affecting

1 emotional wellbeing. A recent study observed that colorectal cancer patients with limited financial
2 reserves (i.e. savings) 4-months post-diagnosis had a significantly higher symptom burden⁴⁰ and,
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4 since symptoms are strong predictors of HRQoL, this provides another possible explanation. Future
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6 studies should seek to test whether cancer-related financial distress affects HRQoL by influencing
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8 psychological wellbeing, symptom burden, or through some other route. There is also a need to
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10 understand the (potentially different) pathways underlying development of objective and subjective
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12 cancer-related financial distress; it is possible that distinct interventions or supports may be needed
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14 to alleviate these different dimensions of the financial impact of cancer.
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21 ***Practice Implications***

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23 The relationship between financial impact of cancer and low HRQoL means healthcare professionals
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25 should be alert to the possibility of financial distress (objective or subjective) among survivors, and
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27 seek to identify this at an early stage. From a policy- and decision-maker perspective, the
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29 development of strategies or supports to alleviate the (objective or subjective) financial impact of
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31 colorectal cancer could lead to improved HRQoL.
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38 ***Strengths & Limitations***

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40 Although study participants were identified from a population-based sampling frame, the response
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42 rate was only 39%. It was reassuring, therefore, that the socio-demographic and clinical
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44 characteristics of respondents and non-respondents differed only in age and age was not a
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46 significant predictor of HRQoL. Some people who returned the questionnaire did not complete the
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48 HRQoL questions or the questions on cancer-related financial stress and strain; although numbers
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50 were small, those who did not complete these sections tended to be older on average than those
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52 who did. We cannot exclude the possibility that those who completed all of the questions, those
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54 who completed some, and non-respondents differed in cancer-related financial stress or strain or
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56 HRQoL. The questions on cancer-related financial stress and strain had been used in previous studies
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1 and showed good convergent validity with other markers of the financial burden of cancer in
2 survivors in Ireland.²⁰ They were designed to investigate objective and subjective aspects of the
3 financial impact of cancer¹⁶ and – as far as we are aware - this is the first study of these two
4 dimensions of financial burden in colorectal cancer survivors. However, we acknowledge that both
5 questions are somewhat subjective in nature in that they ask about respondents' own views of the
6 financial impact of cancer on their household and self. In addition, we lacked information on
7 comorbid conditions, and it is possible that (although the questions asked about the impact of the
8 cancer) for some survivors the financial hardship may result from presence of other conditions.
9 Moreover, we note that the data was collected some time ago (notably, before the full impact of the
10 economic crisis in Ireland). It is therefore unclear whether current frequencies of financial stress and
11 strain would be the same as reported here. Finally, in common with other studies on this topic, it
12 cannot be assumed that the prevalence of financial hardship (irrespective of how measured) in
13 Ireland is representative of experiences in other countries.

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33 Because assumptions underlying linear regression were violated we used logistic regression for our
34 primary analysis. A lack of a generally-recognised threshold for low HRQoL (as measured using the
35 global health score from the EORTC QLQ-C30) led us to define this *a priori* as the lowest quantile, but
36 whether this corresponds to clinical importance is unknown. Thresholds for clinical importance have
37 recently been published for several other EORTC QLQ-C30 subscales;⁴¹ a similar thresholds for the
38 global health score would be of considerable value.

39 40 41 42 43 44 45 46 47 48 49 *Conclusions*

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52 In this first study to distinguish between objective and subjective measures of cancer-related
53 financial impact in colorectal cancer, four in every 10 survivors reported objective cancer-related
54 financial stress, four in 10 reported subjective cancer-related financial strain, and one-third reported
55 both. Survivors experiencing cancer-related financial stress and/or strain had significantly increased
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odds of low health-related quality-of-life, and the differences in HRQoL between those with and without financial stress or strain were clinically significant. Further research is needed to better understand the routes by which financial distress affects HRQoL among cancer survivors. Meantime, greater recognition of the (objective and subjective) financial impact of cancer on survivors and their families, and the development of strategies to alleviate this, could yield HRQoL benefits.

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Figure Legends

Figure 1: Distribution of cancer-related financial stress and strain among colorectal cancer survivors

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Table 1. Characteristics of colorectal cancer survivors included in analysis. Numbers and percentages.

	Number	%
Total	493	100.0
Demographic variables		
<i>Sex</i>		
Male	310	62.9
Female	183	37.1
<i>Age at time of questionnaire completion</i>		
<65	194	39.4
65-74	163	33.1
75+	136	27.6
<i>Marital status at diagnosis</i>		
Married/cohabiting	373	75.8
Other	119	24.2
Not reported	1	
<i>Living alone at time of diagnosis</i>		
No	409	83.5
Yes	81	16.5
Not reported	3	
<i>Children</i>		
Yes	420	86.2
No	67	13.8
Not reported	6	
<i>Nationality</i>		
Irish	467	94.9
Other	25	5.1
Not reported	1	
Socio-economic variables		
<i>Highest level of education completed</i>		
Primary	146	29.9
Secondary	236	48.3
Tertiary	107	21.9
Not reported	4	
<i>Employment status at diagnosis</i>		
Employed/self-employed	188	38.9
Retired	203	42.0
Other	92	19.1
Not reported	10	

<i>Main earner in household</i>		
Survivor	300	62.6
Spouse/other	118	24.6
Shared between survivor/spouse	61	12.7
Not reported	14	

<i>Private health insurance at diagnosis</i>		
No	239	48.5
Yes	254	51.5

<i>Medical card at diagnosis¹</i>		
Yes	241	48.9
No	252	51.1

Clinical variables

<i>Time since diagnosis</i>		
<1 year	185	37.5
1-2 years	234	47.5
>2 years	74	15.0

<i>Site</i>		
colon	305	61.9
rectum	188	38.1

<i>Stage at diagnosis</i>		
Stage 1	91	18.5
Stage 2	141	28.6
Stage 3	175	35.5
Stage 4	36	7.3
Not known/ not staged	50	10.1

<i>Cancer-directed surgery</i>		
Yes	425	86.2
No	68	13.8

<i>Chemotherapy</i>		
Yes	138	28.0
No	355	72.0

<i>Radiotherapy</i>		
Yes	80	16.2
No	413	83.8

<i>Number of treatments received</i>		
None	44	8.9
1	286	58
2	132	26.8
3	31	6.3

Currently has a stoma

Yes	105	21.3
No	388	78.7

¹ eligibility based on financial means and age; provides access to healthcare in public system, GPs, and prescription medications free at the point of delivery

Table 2. Associations between significant demographic, socio-economic and clinical variables and low HRQoL: numbers and % with low HRQoL, adjusted odds ratios (AdjOR)¹ with 95% confidence intervals (CI), and p values from likelihood ratio tests

	<i>Number</i>	<i>%</i>	<i>AdjOR</i>	<i>95% CI</i>	<i>p</i>
<i>Children</i>					
Yes	98	24.2	1.00	-	0.008
No	26	40.0	2.18	1.24-3.83	
<i>Highest level of education completed</i>					
Primary	47	34.0	1.97	1.21-3.19	0.021
Secondary	51	22.1	1.00	-	
Tertiary	26	24.8	1.17	0.67-2.04	
<i>Chemotherapy</i>					
No	98	28.6	1.00	-	0.037
Yes	26	19.9	0.59	0.36-0.98	
<i>Current stoma</i>					
No	87	23.4	1.00	-	0.019
Yes	37	36.3	1.80	1.11-2.92	

¹ mutually adjusted for the variables shown in the table

Table 3. Associations between cancer-related financial impact and low HRQoL, adjusted for demographic, socio-economic and clinical variables: numbers and % with low HRQoL, adjusted odds ratios (AdjOR)¹ with 95% confidence intervals (CI), and p values from likelihood ratio tests

	<i>Number</i>	<i>%</i>	<i>AdjOR</i>	<i>95% CI</i>	<i>p</i>
<i>Cancer-related financial stress²</i>					
financial stress better since diagnosis	1	10.0	0.45	0.06-3.71	<0.001
no change	48	18.8	1.00	-	
financial stress worse since diagnosis	71	37.8	2.54	1.62-3.99	
<i>Cancer-related financial strain³</i>					
financial strain better since diagnosis	8	14.0	0.61	0.26-1.39	0.009
no change	50	22.8	1.00	-	
financial strain worse since diagnosis	62	34.3	1.73	1.09-2.72	
<i>Cancer-related financial impact</i>					
neither stress nor strain worse	44	19.2	1.00	-	<0.001 ⁴
either stress or strain worse	18	23.7	1.39	0.73-2.65	
both stress and strain worse	57	39.0	2.59	1.59-4.22	

¹ adjusted for having children, highest level of education completed, receipt of chemotherapy and current stoma

² impact of cancer diagnosis on household's ability to make ends meet

³ feelings about household financial situation since cancer diagnosis

Supplementary Table 1: Univariate associations between variables and low HRQoL. Numbers and percentages with low HRQoL, odds ratios (OR), 95% confidence intervals (OR) and p values from likelihood ratio tests

	Number	%	OR	95%CI	p
Demographic variables					
<i>Sex</i>					
Male	77	25.7	1	-	0.749
Female	47	27.0	1.07	0.70-1.64	
<i>Age at time of questionnaire completion</i>					
<65	43	22.6	1	-	0.324
65-74	44	27.5	1.30	0.80 - 2.11	
75+	37	29.8	1.45	0.87 - 2.43	
<i>Marital status at diagnosis</i>					
Married/cohabiting	90	25.1	1	-	0.414
Other	34	29.1	1.21	0.76-1.93	
<i>Living alone at diagnosis</i>					
No	100	25.5	1	-	0.502
Yes	23	29.1	1.20	0.70 - 2.06	
<i>Children</i>					
Yes	98	24.2	1	-	0.010
No	26	40.0	2.09	1.21-3.60	
<i>Nationality</i>					
Irish	116	25.8	1	-	0.423
Other	8	33.3	1.44	0.60-3.45	
Socio-economic variables					
<i>Highest level of education completed</i>					
Primary	47	34.0	1.82	1.14-2.92	0.041
Secondary	51	22.1	1	-	
Tertiary	26	24.8	1.16	0.68-2.00	
<i>Employment status at diagnosis</i>					
Employed/self-employed	43	23.4	1	-	0.447
Retired	57	29.1	1.34	0.85-2.13	
Other	22	25.9	1.15	0.63-2.07	
<i>Main earner in household</i>					
Survivor	85	29.1	1	-	0.179
Spouse/other	24	21.1	0.65	0.39 -1.09	
Shared between survivor/spouse	13	22.0	0.69	0.35-1.34	
<i>Private health insurance at diagnosis</i>					
No	62	25.9	1	-	
Yes	62	24.1	0.92	0.61-1.38	0.695
<i>Medical card at diagnosis</i>					
No	55	22.8	1	-	
Yes	69	27.4	1.27	0.83-1.92	0.243

Clinical variables

Time since diagnosis

<1 year	44	24.7	0.87	0.56-1.37	0.831
1-2 years	61	27.4	1	-	
>2 years	19	26.0	0.93	0.51-1.70	

Site

Colon	67	23.0	1	-	0.059
Rectum	57	31.0	1.49	0.99 - 2.26	

Stage at diagnosis

Stage 1	22	25.0	0.85	0.47-1.53	0.718
Stage 2	31	23.1	0.77	0.45-1.30	
Stage 3	47	28.1	1	-	
Stage 4	8	22.9	0.76	0.32-1.78	
Not known/ not staged	16	32.0	1.20	0.61-2.38	

Cancer-directed surgery

Yes	14	21.5	1	-	
No	110	26.9	1.34	0.71-2.52	0.353

Chemotherapy

No	98	28.6	1	-	0.049
Yes	26	19.9	0.62	0.38 - 1.01	

Radiotherapy

No	106	26.7	1	-	0.540
Yes	18	23.4	0.84	0.47 - 1.48	

Number of treatments received

None	9	21.4	0.63	0.29-1.37	0.068
1	84	30.3	1	-	
2	23	18.4	0.52	0.31-0.87	
3	8	26.7	0.84	0.36-1.95	

Currently has a stoma

Yes	87	23.4	1	-	0.011
No	37	36.3	1.86	1.17-2.98	

Financial impact variables

Cancer-related financial stress¹

financial stress better since diagnosis	1	10.0	0.48	0.06-3.87	<0.001
no change	48	18.8	1	-	
financial stress worse since diagnosis	71	37.8	2.61	1.70-4.03	

Cancer-related financial strain²

financial strain better since diagnosis	8	14.0	0.55	0.25-1.24	0.003
no change	50	22.8	1	-	
financial strain worse since diagnosis	62	34.3	1.76	1.13-2.73	

Cancer-related financial impact

neither stress nor strain worse	44	19.2	1	-	<0.001
either stress or strain worse	18	23.7	1.30	0.70-2.43	
both stress and strain worse	57	39.0	2.69	1.69-4.30	

¹ impact of cancer diagnosis on household's ability to make ends meet

² feelings about household financial situation since cancer diagnosis

Supplementary Table 2: HRQoL scores by cancer-related financial impact: means, standard deviations (sd) and p values from analysis of variance F test

	<i>Mean</i>	<i>sd</i>	<i>p</i>
<i>Cancer-related financial stress</i> ¹			
financial stress better since diagnosis	81.7	19.6	<0.001
no change	74.8	19.8	
financial stress worse since diagnosis	61.9	22.0	
<i>Cancer-related financial strain</i> ²			
financial strain better since diagnosis	74.9	22.9	<0.001
no change	73.1	20.6	
financial strain worse since diagnosis	63.9	21.2	
<i>Cancer-related financial impact</i>			
neither stress nor strain worse	75.2	20.2	<0.001
either stress or strain worse	68.1	21.0	
both stress and strain worse	61.6	21.6	

¹ impact of cancer diagnosis on household's ability to make ends meet

² feelings about household financial situation since cancer diagnosis

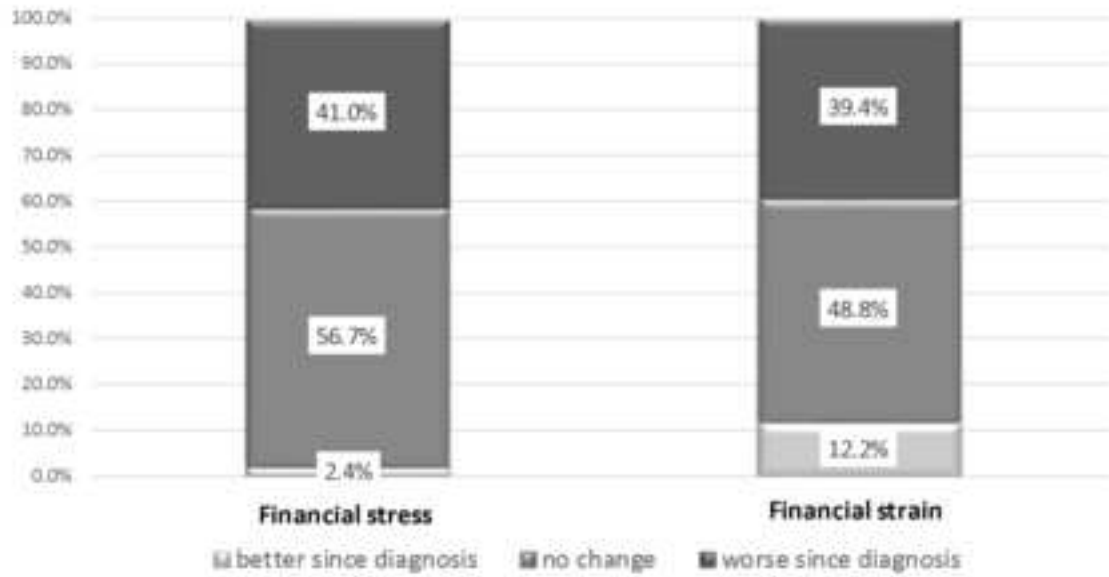
Supplementary Table 3. Sensitivity analysis - linear regression: associations between cancer-related financial impact and HRQoL, adjusted for demographic, socio-economic and clinical variables: coefficients, standard errors, 95% confidence intervals (CI) and p values

	<i>Coefficient</i> ¹	95% CI	<i>p</i>
<i>Cancer-related financial stress</i> ²			
financial stress better since diagnosis	-12.04	-15.98 to -8.09	<0.001
no change	ref	-	
financial stress worse since diagnosis	7.02	-5.99 to 20.03	
<i>Cancer-related financial strain</i> ³			
financial strain better since diagnosis	-8.61	-12.76 to -4.47	0.009
no change	ref	-	
financial strain worse since diagnosis	0.85	-5.32 to 7.01	
<i>Cancer-related financial impact</i>			
neither stress nor strain worse	ref	-	<0.001
either stress or strain worse	-7.46	-12.86 to -2.06	
both stress and strain worse	-12.66	-17.01 to -8.32	

¹ adjusted for having children, highest level of education completed, receipt of chemotherapy and current stoma

² impact of cancer diagnosis on household's ability to make ends meet

³ feelings about household financial situation since cancer diagnosis





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