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BRIEF COMMUNICATION

Exploring household income as a predictor of psychological well-being among long-term colorectal cancer survivors

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Abstract
Purpose The purpose of this analysis was to determine the unique contribution of household income to the variance explained in psychological well-being (PWB) among a sample of colorectal cancer (CRC) survivors.
Methods This study is a secondary analysis of data collected as part of the Health-Related Quality of Life in Long-Term Colorectal Cancer Survivors Study, which included CRC survivors with (cases) and without (controls) ostomies. The dataset included socio-demographic, health status, and health-related quality of life (HRQOL) information. HRQOL was assessed with the modified City of Hope Quality of Life (mCOH-QOL)-Ostomy questionnaire and SF-36v2. To assess the relationship between income and PWB, a hierarchical linear regression model was constructed combining data from both cases and controls.
Results After accounting for the proportion of variance in PWB explained by the other independent variables in the model, the additional variance explained by income was significant (R^2 increased from 0.228 to 0.250; $P = 0.006$).
Conclusions Although the study design does not allow causal inference, these results demonstrate a significant relationship between income and PWB in CRC survivors. The findings suggest that for non-randomized group comparisons of HRQOL, income should, at the very least, be included as a control variable in the analysis.

Keywords Income · Psychological well-being · Physical well-being · Colorectal cancer

Abbreviations

CRC	Colorectal cancer
SES	Socioeconomic status
mCOH-QOL-Ostomy	Modified City of Hope Quality of Life-Ostomy questionnaire
HRQOL	Health-related quality of life
PCS	SF-36 physical component summary scale
MCS	SF-36 mental component summary scale
PWB	Psychological well-being

Introduction

In 2003, about 20 million families in the US were estimated to have problems paying medical bills; two-thirds of these families had some type of health insurance coverage [1]. Himmelstein et al. [2] found that cancer was the general diagnosis with the highest out-of-pocket medical expenditures leading to bankruptcy in the US in 2001. The results of their analysis suggested that about half of all bankruptcies in

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the US were due to medical bills. Dranove and Millenson [3] challenged the conclusions of Himmelstein et al. and asserted that medical bills were a cause of closer to 17% of the bankruptcies analyzed. Nevertheless, both groups of researchers agreed that "too many vulnerable Americans are financially devastated by the cost of illness" [2].

Potential outcomes that fall short of financial devastation deserve attention from researchers and policymakers. Financial strain and disparities in health and well-being associated with income are increasingly being examined among cancer survivors. For example, Ell et al. [4] found that economic stress was associated with lower levels of well-being among predominately Hispanic women with a primary diagnosis of breast or a gynecological cancer. Short and Farley [5] identified income-related disparities in health-related quality of life that were not explained by the effect of health on earnings. This latter study was significant in that it recognized that income is likely to be affected by health, and health is likely to be affected by income (i.e., endogeneity). The relationship between income and well-being for long-term cancer survivors, in whom even successful treatment has potentially negative consequences, can be significant [5].

One group for which this may be the case is long-term colorectal cancer (CRC) survivors. It is estimated that there are over 1.1 million CRC survivors in the US [6]. Many of these individuals, especially those with low-rectal cancers, have received permanent intestinal stomas (ostomies), leaving a critical need to better understand how ostomies affect their lives and well-being. Ostomies are the surgical exteriorization of the bowel to the anterior abdominal wall, allowing intestinal waste to flow directly into an external pouch (appliance). A long history of research has addressed the physical and psychosocial consequences of having CRC with or without an ostomy [6–8].

Although substantial evidence links higher levels of socioeconomic status (SES) to higher levels of health status in a variety of populations [9–20], the relationship between income and physical and psychological well-being has not been sufficiently explored in the long-term CRC survivor population. This relationship has increasing importance as survivorship increases and the long-term effects of permanent changes in bowel function emerge. The purpose of this analysis was to explore the unique contribution of household income to the variance explained in psychological well-being among long-term (≥5 years) CRC survivors.

Methods

Subjects

This study is a secondary analysis of data collected in the Health-Related Quality of Life in Long-Term Colorectal Cancer Survivors Study, which was designed to assess the subjective experience of living with an ostomy. A detailed description of the overall study methodology is presented elsewhere [21]. A cross-sectional, survey research design was employed in which 679 respondents [284 CRC survivors with ostomies (cases); 395 CRC survivors without ostomies (controls)] completed a mailed questionnaire that included health-related quality of life (HRQOL) scales along with socio-demographic, health, and health-care utilization items. Subjects were recruited from three regions of a national prepaid group practice health maintenance organization, and a 52% (679/1,308) response rate was obtained. For the purpose of this secondary analysis, the case and control subjects were combined, and complete data were available for all required variables from 588 subjects. The study was approved by the human subjects committees at each site.

Measures

Medical records and subject self-report were the data sources. A comprehensive socio-demographic and medical history was obtained for study participants from each site's automated information system. Data regarding the subjects' age, sex, and ostomy status were obtained from the information system. In addition, the Charlson-Deyo comorbidity index [22] was constructed from ICD-9-CM codes from outpatient and inpatient encounters during the year prior to completion of the study questionnaire. A Charlson-Deyo index score of 0 indicates no comorbidities are present; higher index scores indicate a higher comorbidity burden.

The self-reported measures included the modified City of Hope Quality of Life (mCOH-QOL)-Ostomy questionnaire [23] and the SF-36v2 [24], both of which have demonstrated high reliability and validity in numerous patient samples [23–28]. Along with socio-demographic information (e.g., education, race/ethnicity, partner status, and household income), the mCOH-QOL-Ostomy questionnaire provides scale scores for the following four domains: physical, psychological, social, and spiritual well-being. The scale scores are on an 11-point scale where 0 = poorest and 10 = best [23]. The score of the mCOH-QOL-Ostomy questionnaire's psychological well-being (PWB) scale, which has 13 items covering a variety of emotional and cognitive issues (e.g., depression, anxiety, hope, fear of recurrence, remembering), was the dependent variable in this analysis. Due to the inclusion of ostomy-specific items, an abridged version of the mCOH-QOL-Ostomy questionnaire was used for the control subjects. The PWB scale in the abridged version has one less item than the unabridged version; however, there is evidence that the removal of the ostomy-specific item did not

meaningfully diminish the reliability or construct validity of the scale [21]. The response categories for self-reported annual household income on the mCOH-QOL-Ostomy questionnaire were "Less than $15,000," "$15,000 to $30,000," "$30,001 to $50,000," "$50,001 to $75,000," "$75,001 to $100,000," and "Greater than $100,000."

The SF-36v2 produces scores for eight multi-item scales and physical (PCS) and mental (MCS) component summary scores based on a population norm-based scoring function [24]. Only the PCS score was used in this analysis as an independent variable in the model. It was calculated with QualityMetric's Health Outcomes Scoring Software 2.0 (©QualityMetric, Lincoln, RI, 2004–2007).

Statistical analysis

To assess the unique contribution that household income makes to PWB, a hierarchical linear regression model was constructed. In the model, we explored the contribution of income to the variance in the mCOH-QOL-Ostomy questionnaire's PWB score over and above the following independent variables: physical health (SF-36v2 PCS),

Table 1 Hierarchical regression results; dependent variable is psychological well-being (PWB)

	Model 1 ($n = 588$)		Model 2 ($n = 588$)	
	Coefficient (SE)	95% CI	Coefficient (SE)	95% CI
SF-36v2 PCS score	0.06 (0.01)**	0.05 to 0.07	0.06 (0.01)**	0.04 to 0.07
Charlson-Deyo 1[a]	0.26 (0.19)	−0.15 to 0.61	0.25 (0.19)	−0.13 to 0.63
Charlson-Deyo 2[a]	−0.08 (0.16)	−0.42 to 0.22	−0.16 (0.16)	−0.47 to 0.16
Charlson-Deyo 3[a]	−0.28 (0.24)	−0.90 to 0.05	−0.43 (0.24)	−0.90 to 0.04
Charlson-Deyo 4[a]	0.14 (0.31)	−0.50 to 0.73	0.03 (0.31)	−0.59 to 0.63
Charlson-Deyo 5[a]	−0.45 (0.40)	−1.22 to 0.35	−0.36 (0.40)	−1.14 to 0.42
Charlson-Deyo 6[a]	−0.61 (0.34)	−1.18 to 0.17	−0.49 (0.34)	−1.15 to 0.18
Charlson-Deyo 7[a]	−0.43 (0.57)	−1.83 to 0.43	−0.77 (0.57)	−1.89 to 0.35
Charlson-Deyo 8[a]	−0.32 (0.76)	−1.83 to 1.13	−0.41 (0.75)	−1.88 to 1.06
Charlson-Deyo 9[a]	1.62 (1.07)	−0.50 to 3.68	1.73 (1.06)	−0.35 to 3.81
Age	0.03 (0.01)*	0.01 to 0.04	0.03 (0.01)**	0.02 to 0.04
Female	0.02 (0.13)	−0.17 to 0.35	0.08 (0.13)	−0.18 to 0.35
Hispanic[b]	0.18 (0.30)	−0.41 to 0.76	0.11 (0.30)	−0.47 to 0.70
African American[b]	−0.31 (0.37)	−1.13 to 0.33	−0.33 (0.37)	−1.06 to 0.40
Asian[b]	−0.30 (0.22)	−0.70 to 0.15	−0.22 (0.22)	−0.65 to 0.20
Other[b]	−0.28 (0.29)	−0.77 to 0.36	−0.18 (0.29)	−0.74 to 0.39
High school/GED[c]	0.31 (0.23)	−0.13 to 0.75	0.33 (0.23)	−0.12 to 0.77
Vocational/business[c]	0.22 (0.32)	−0.49 to 0.76	0.14 (0.32)	−0.48 to 0.75
Some college[c]	0.32 (0.23)	−0.16 to 0.74	0.21 (0.24)	−0.25 to 0.68
College graduate[c]	0.48 (0.25)	−0.05 to 0.93	0.26 (0.26)	−0.24 to 0.76
Some graduate school[c]	0.58 (0.31)*	0.04 to 1.27	0.46 (0.32)	−0.17 to 1.09
Graduate degree[c]	0.36 (0.26)	−0.12 to 0.90	0.18 (0.27)	−0.36 to 0.71
Married/partnered	0.34 (0.14)**	0.06 to 0.60	0.22 (0.15)	−0.07 to 0.51
Ostomy	−0.32 (0.13)*	−0.53 to −0.04	−0.29 (0.13)*	−0.54 to −0.05
$15,000–$30,999[d]			0.04 (0.24)	−0.43 to 0.51
$31,000–$50,999[d]			0.08 (0.25)	−0.42 to 0.58
$51,000–$75,999[d]			0.50 (0.28)	−0.05 to 1.06
$76,000–$100,000[d]			0.81 (0.32)*	0.17 to 1.44
>$100,000[d]			0.82 (0.35)*	0.13 to 1.51
Constant	2.76 (0.70)*		2.31 (0.73)**	0.89 to 3.73
F	6.92 ($P < 0.001$)		6.41 ($P < 0.001$)	
R-squared	0.2278		0.2500	
Change in *R*-squared			0.0222 ($P = 0.006$)	

Reference groups: [a] Charlson-Deyo = 0; [b] non-Hispanic White; [c] <high school; [d] <$15 k

* $P < 0.05$, ** $P < 0.01$

comorbidity (Charlson-Deyo index), age, sex, race/ethnicity, education, partnered status, and presence of an ostomy.

Model 1: PWB score $= \beta_0 + \beta_{PCS} + \beta_{Charlson\text{-}Deyo} + \beta_{Age} + \beta_{Sex} + \beta_{Race/ethnicity} + \beta_{Education} + \beta_{Partnered\ Status} + \beta_{Ostomy}$

Model 2: PWB score $= \beta_0 + \beta_{PCS} + \beta_{Charlson\text{-}Deyo} + \beta_{Age} + \beta_{Sex} + \beta_{Race/ethnicity} + \beta_{Education} + \beta_{Partnered\ Status} + \beta_{Ostomy} + \beta_{Income}$

Results

After accounting for the proportion of variance in PWB explained by the other independent variables in the model (Table 1), the additional variance explained by income was significant (R^2 increased from 0.228 to 0.250; $P = 0.006$). When compared to those in the highest household income category (>$100,000), subjects in the lowest income category (<$15,000) had a 0.82 point lower PWB score on the 11-point scale. Significant positive predictors of PWB were SF-36v2 PCS score, age, and absence of an ostomy.

Discussion

Our exploratory analysis demonstrated a significant relationship between household income and PWB in CRC survivors. However, the study has several limitations, including the use of household income rather than income directly attributable to the CRC survivor. The use of household income is based on the unitary theory of the household. Under this model, choices made by the household (e.g., obtaining health care for a household member) are made irrespective of the source of income [29]. It is also interesting to note that the variables "married/partnered" and "some graduate school" were not statistically significant predictors in the model to which income was added hierarchically. This change may reflect the positive correlation between household income and these two variables. In addition, we captured the associations between PWB and household income, and all other omitted factors correlated with income (e.g., IQ, willingness to work hard).

A dominant belief among medical scientists is that the evidence points to a causal relation between sustained economic hardship and poor health and well-being [16–19]. Conversely, economists have argued that the causality may run primarily from health to SES, through factors such as the ability to work and to consume more efficiently and thereby accumulate wealth [20, 21]. Hence, we realize that our dependent variable (i.e., psychological well-being) might influence our predictor variable (i.e., household income). However, we did not intend our exploratory analysis to lead to causal inferences.

Based on the work of Norman et al. [30], the 0.82 difference in PWB score between the highest and lowest household income categories is not only statistically significant, but also clinically meaningful as well. This finding merits further consideration when attempting to interpret patient-reported outcomes, particularly HRQOL. The findings suggest that for non-randomized group comparisons of HRQOL, income should, at the very least, be included as a control variable in the analysis. There may be effects of SES on health and well-being and vice versa. Although this dynamic association may exist, it is not necessary to make a priori assumptions about which association is stronger [31]. Researchers must be aware of this relationship and control for resulting endogeneity.

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