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Psychological Needs Satisfaction, Self-Rated Health and the Mediating Role of Exercise Among Testicular Cancer Survivors

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Abstract

Exploring tenets of basic psychological needs theory, the objective of this study was to examine the association between psychological needs satisfaction, exercise behavior, and physical and mental health among testicular cancer survivors. The present study investigated whether psychological needs satisfaction was directly associated with increased self-rated health, and if this relationship was mediated by engagement in exercise. Testicular cancer survivors ($N = 135$; $M_{age} = 32.45$; $SD = 7.63$) self-reported current psychological needs satisfaction, exercise behavior, and perceived global physical and mental health during routine oncology visits. Associations were examined using path analysis. Psychological needs satisfaction was a positive correlate of both self-rated physical and mental health in this sample, and exercise mediated the association between needs satisfaction and self-rated physical health. This study supports the assumptions underpinning basic psychological needs theory in this unique clinical population. Based on the findings, exercise engagement represents one mechanism associated with perceived health after cancer. Supportive care interventions should aim to enhance satisfaction of psychological needs and investigate exercise as a mechanism underpinning the relationship between needs satisfaction and perceived health in testicular cancer survivors.

Keywords

testicular cancer survivors, exercise, basic psychological needs theory, physical health, mental health

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Testicular cancer is the most common cancer diagnosed in men aged 15–39 (Canadian Cancer Statistics Advisory Committee, 2019). Favourable 5-year survival rates (97%) denote a growing population of men whose health may have been negatively impacted by this disease and its treatments (Albers et al., 2015). Compared to other oncology groups (e.g., survivors of childhood cancers), reports outlining the global survivorship experience of men with testicular cancer are limited. There is evidence that testicular cancer and its treatments (i.e., chemotherapy, radiotherapy, and surgery) increases survivors' risk of developing cardiovascular disease, secondary cancers, peripheral neuropathy, cognitive deficits, pulmonary toxicity, renal dysfunction, loss of hearing or tinnitus, hypogonadism, cancer-related fatigue, infertility, and sexual dysfunction (Christensen et al., 2015; Fosså et al., 2018; Haugnes et al., 2012; Smith et al., 2013). Testicular cancer survivors experience high levels of fear of recurrence and are at an increased risk of anxiety and depression long term (Dahl et al., 2005; Shinn et al., 2007; Skaali et al., 2009). These physical and mental health concerns are often overlooked and go untreated.

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The examination of potential antecedents of testicular cancer survivors' health across the cancer continuum is warranted (D'Agostino et al., 2011).

Self-rated health is an encompassing variable that integrates physical and mental health perceptions and, even using single-item assessments, is a reliable predictor of morbidity and mortality (Picard et al., 2013). Specifically, self-rated health assesses an individual's subjective appraisal of their general health and is purported to provide valuable insight into the current state of one's health that is not captured by assessing physical and mental symptoms individually (Mavaddat et al., 2011). Often assessed using single overarching questions specific to health (physical health and mental health), these self-rated health reflections are used in major national and international surveillance and monitoring data collections, including the Canadian Community Health Survey and the World Health Survey (Statistics Canada, 2013; World Health Organization, 2002). Identifying factors that influence testicular cancer survivors' self-rated physical and mental health can contribute to the development of targeted strategies for holistic health promotion in this population.

Psychological needs (i.e., competence, autonomy, relatedness) are likely one such factor that can affect self-rated physical and mental health. Basic psychological needs theory (Ryan & Deci, 2002), a sub-theory of the self-determination theory framework (Ryan & Deci, 2017), postulates that fulfillment of the needs for *competence* (i.e., being effective and able), *relatedness* (i.e., social connection, belonging within a group, and the experience of reciprocal caring for by those around you), and *autonomy* (i.e., one's volition, as well as experiences of choice in, and endorsement of an action) is necessary for an individual's physical and psychological health (De Charms, 2013; Ryan & Deci, 2002; Vansteenkiste et al., 2010). Psychological needs are important both generally and within specific contexts such as exercise. Specifically, cancer survivors who report higher autonomy, competence, and relatedness for exercise report better psychological health (Mack et al., 2013; Peddle et al., 2008). Based on theory (Ryan & Deci, 2002) and empirical evidence (McDonough & Crocker, 2007; Teixeira et al., 2012), psychological needs may have unique associations to self-report health outcomes. Furthermore, engagement in exercise may be a mechanism that helps to explain the relationship between psychological needs satisfaction within the context of exercise and self-rated health.

Psychological need satisfaction is associated with greater levels of exercise behavior in breast and colorectal cancer survivors (e.g., Elías et al., 2017; Mack et al., 2013), yet this relationship has not been tested with testicular cancer survivors. Testicular cancer survivors may be a subgroup of survivors who are more active than age matched controls (Abu Zaid et al., 2016; Thorsen et al., 2003), yet the function of exercise for mental and physical health self-perceptions is understudied. Furthermore, the link between the satisfaction of psychological needs for exercise, exercise behavior, and self-rated health has not been studied among male clinical populations and may offer practical implications for interventions targeting health perceptions and behaviors.

Exercise has been identified as an effective nonpharmacological intervention in improving the physical and mental health of cancer survivors' both while on treatment and well into survivorship (Courneya et al., 2002; Sabiston & Brunet, 2012; Warburton & Bredin, 2017; Zhao et al., 2013). Specific to testicular cancer survivors, exercise interventions have led to improvements in many self-reported physical and mental health indicators (Adams et al., 2017, 2018; Thorsen et al., 2005). Given the importance of understanding and promoting physical and mental health in testicular cancer survivors, further examination of the role of exercise in the relationship between psychological need satisfaction and self-rated health is warranted.

The Present Study

The purpose of this cross-sectional study was to test the relationship between psychological need satisfaction, exercise behavior, and self-rated physical and mental health among a sample of testicular cancer survivors. Consistent with existing literature (McDonough & Crocker, 2007; Ryan & Deci, 2002), it was hypothesized that psychological need satisfaction would be directly associated with better self-rated health, and this relationship would be mediated by engagement in exercise.

Methods

Procedures and Participants

Convenience sampling was used to target testicular cancer survivors who were approached during routine oncology clinic visits (between April and September 2018) at a major adult cancer centre in Canada. The multidisciplinary testicular cancer clinic provides care to survivors from across the province. Survivors were screened by their oncologist and were eligible to complete the questionnaire if they were (i) 18 years of age or older; (ii) had a known diagnosis of testicular cancer that occurred between the ages of 15 and 39 (not limited by stage, time since diagnosis, or treatments received); (iii) were proficient in English. Participants who met eligibility and provided written informed consent were given the questionnaire to complete on site by the first author

(research clinician working within the centre). Ethics approval for this study was obtained from the University Health Network Research Ethics Board (Princess Margaret Cancer Centre, approval #15-5083) prior to initiating recruitment. This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (see supplemental file 1).

Sample size estimates were based on the path model including four measured manifest variables, a correlation among the self-rated health outcomes, and direct and indirect paths among the variables. Standard protocol for structural equation modeling suggests 20 participants per path to be estimated (Stevens, 2012). With six estimated paths, a sample of 120 men was targeted to obtain sufficiently accurate estimates (Wolf et al., 2013). To account for possible missing data or withdrawal from the study, we over-sampled to a target of $N = 135$. The half-day testicular cancer clinic was held once per week and visited 19 times within a 6-month period and recruitment ceased when 135 testicular cancer survivors had completed the questionnaire.

Measures

Descriptive Information. Demographic (e.g., age, ethnicity, marital status) and cancer-related (e.g., cancer stage, diagnosis date, treatment status, treatments received) variables were collected via the self-report questionnaire.

Psychological Need Satisfaction. The 18-item Psychological Need Satisfaction in Exercise (PNSE) scale (Wilson et al., 2006) was used to assess perceived satisfaction of the basic psychological need for competence ($N_{items} = 6$; e.g., "I feel capable of completing exercises that are challenging to me"), autonomy ($N_{items} = 6$; e.g., "I feel free to choose which exercises I participate in"), and relatedness ($N_{items} = 6$; e.g., "I feel connected to the people who I interact with while we exercise together") within the context of exercise. Participants were asked to indicate how they typically feel while exercising on a scale of 0 (false) to 5 (true) for each statement. To address the interdependent nature of psychological needs (Ryan & Deci, 2000), scores across the three needs were averaged to create a psychological need satisfaction composite score, with higher scores representation higher need satisfaction. The PNSE scale has been reported to be a valid and reliable measure of need satisfaction within the context exercise including within cancer survivors (Mack et al., 2013; Peddle et al., 2008; Wilson et al., 2008). In the current study, the internal consistency Cronbach alpha coefficient was $\alpha = 0.94$.

Exercise. The Godin Leisure Time Exercise Questionnaire (GLTEQ) was used to measure current self-reported exercise (Godin & Shephard, 1985). Participants indicated the frequency of their engagement in mild, moderate, and strenuous exercise during a typical 7-day period. In addition to the original GLTEQ questions, participants were asked to report the average number of minutes of exercise engagement in each intensity of exercise. Given the important health outcomes associated with moderate-to-strenuous intensity exercise, and the guidelines supporting this level of exercise (Segal et al., 2017; Stevinson et al., 2009), a total exercise score was computed as the total number of minutes per week engaged in moderate and strenuous exercise. This adapted measure has been used extensively to measure exercise behavior among cancer survivors (Amireault et al., 2015; Love & Sabiston, 2011; Stevinson et al., 2009; Vallance et al., 2005).

Self-Rated health. Self-rated health was assessed using a single-item question for each of perceived physical health and mental health whereby respondents rate their health on a 5-point likert scale ranging from 1 to 5 ("In general, would you say your physical/mental health is; poor, fair, good, very good, excellent") (Herman et al., 2015; Krause & Jay, 1994; Picard et al., 2013). Single-item self-rated health scores have been reported to be a reliable and valid global assessment of health and is an indicator of physical and mental function (Krause & Jay, 1994; Picard et al., 2013; Piko, 2000; Shields & Shooshtari, 2001).

Data Analysis

To test the hypothesized model, path analysis with maximum likelihood estimation was conducted in R using lavaan (Rosseel, 2012; Team, 2013). The model included one observed exogenous variable (psychological needs satisfaction), a single observed mediator variable (exercise), and two observed endogenous variables (self-rated mental and physical health). Given that the hypothesized model included all possible pathways between the study variables, it was just-identified (i.e., 0 *df*) and model fit was not reported. The model was assessed on the basis of the strength and significance of the model's direct (i.e., paths *a, b1, b*2, *c1*, and *c2*) and indirect (i.e., path *a1b1* and *a1b2*) effects derived from a bootstrapping procedure that drew 5000 resamples with replacement (Hayes, 2009). Mean coefficients and their 95% bias corrected and accelerated confidence intervals are those derived from this bootstrapping procedure.

Results

A total of 135 testicular cancer survivors ($M_{age} = 32.45$, $SD = 7.63$) completed the questionnaire (see Table 1).

Table 1. Personal and Cancer-Specific Characteristics of a Sample of Testicular Cancer Survivors ($N = 135$).

Variable	Score range	Mean (*SD*) or *n* (%)
Age	18–68	32.45 (7.63)
Ethnicity		
Caucasian		97 (72.4%)
Asian		23 (17.2%)
Other		14 (10.4%)
Relationship status		
Single		47 (35.1%)
Married or living with a life partner		72 (53.7%)
In a relationship, but not living with partner		15 (11.2%)
Time since diagnosis (years)		3.99 (5.4)
≤ 1-year		21 (16.3%)
1–2 years		25 (19.4%)
2–3 years		28 (21.7%)
3–5 years		27 (20.9%)
≥ 5-years		28 (21.7%)
Stage at diagnosis	0–40	
Stage I		46 (34.6%)
Stage II		23 (17.3%)
Stage III		23 (17.3%)
Stage IIII		5 (3.8%)
Unknown		36 (27.1%)
Treatments received*		
Surgery		108 (86.4%)
Radiotherapy		6 (4.8%)
Chemotherapy		102 (75.6%)
Stem cell		7 (5.6%)

Note. *Multiple responses given.

Participants were predominantly Caucasian ($n = 97$; 72%), were married or living with a life partner ($n = 72$; 54%), and had completed their cancer treatment ($n = 120$; 90%). Based on exercise recommendations for cancer survivors (≥150 minutes of moderate to strenuous exercise per week; Schmitz et al., 2010), 66% ($n = 76$) of respondents reported meeting guidelines. The majority of participants had been diagnosed with stage I or II testicular cancer ($n = 69$; 52%) within the past five years ($n = 101$; 78%) and had undergone surgery ($n = 109$; 87%).

Preliminary Analysis

Data were first screened for missing values and analysis revealed that there were 97 complete cases and 38 incomplete cases. For those with incomplete data, missing data were determined to be missing completely at random based on the probability of the pattern of missing values diverging from randomness being greater than 0.05 (MCAR $\chi^2 = 52.25$, $df = 44$, $p > .05$). A total of 13 cases had more than 20% of items missing and were removed from the dataset (Tabachnick & Fidell, 2007). Missing values in the remaining cases with incomplete data were imputed using the Expectation Maximization algorithm at the variable level (Cole, 2008; Dempster et al., 1977; Enders & Peugh, 2004). The final sample included in this analysis was 122 testicular cancer survivors. ($M_{age} = 32.37$, $SD = 7.66$). Following data screening, descriptive statistics and correlations for main study variables and covariates were calculated (see Table 2). Bivariate correlations indicated that covariates (age, cancer stage, and time since cancer diagnosis) were not significantly correlated with study variables. Self-rated mental health was significantly positively related to satisfaction of the needs for competence and relatedness but unrelated to autonomy and exercise. Physical health was significantly positively related to satisfaction of psychological need for competence, relatedness, autonomy, and exercise.

Primary Analysis

The final model is presented in Figure 1. The path coefficient between psychological need satisfaction and exercise was significant ($\beta = .31$, CI = .17 to .47), as well as the path from exercise to physical health ($\beta = .18$, CI = .03 to .36). Exercise mediated the relationship

Table 2. Descriptive Statistics and Bivariate Pearson's Correlations for Psychological Needs, Exercise, and Self-Rated Physical and Mental Health in a Sample of Testicular Cancer Survivors.

	1	2	3	4	5	6	7	8	9	10
1. Competence	–									
2. Relatedness	.53**	–								
3. Autonomy	.69**	.40**	–							
4. Psychological needs satisfaction	.87**	.83**	.79**	–						
5. Exercise	.31**	.29*	.15	.31**	–					
6. Mental health	.18*	.20*	.11	.20*	–.01	–				
7. Physical health	.45**	.44**	.28*	.48**	.30**	.39**	–			
8. Age	.01	–.15	.11	–.03	.05	.13	–.02	–		
9. Stage	–.12	.02	.004	–.03	–.06	.03	–.02	.13	–	
10. Time since diagnosis	.11	–.14	.15	.02	–.06	.07	.10	.56**	.11	–
Mean	3.92	3.27	4.31	3.83	296.4	2.44	2.44	32.37	1.65	50.13
Standard deviation	1.14	1.50	1.02	1.01	200.94	1.12	0.87	7.66	1.58	65.73

Note. *$p < .05$. **$p < .001$.

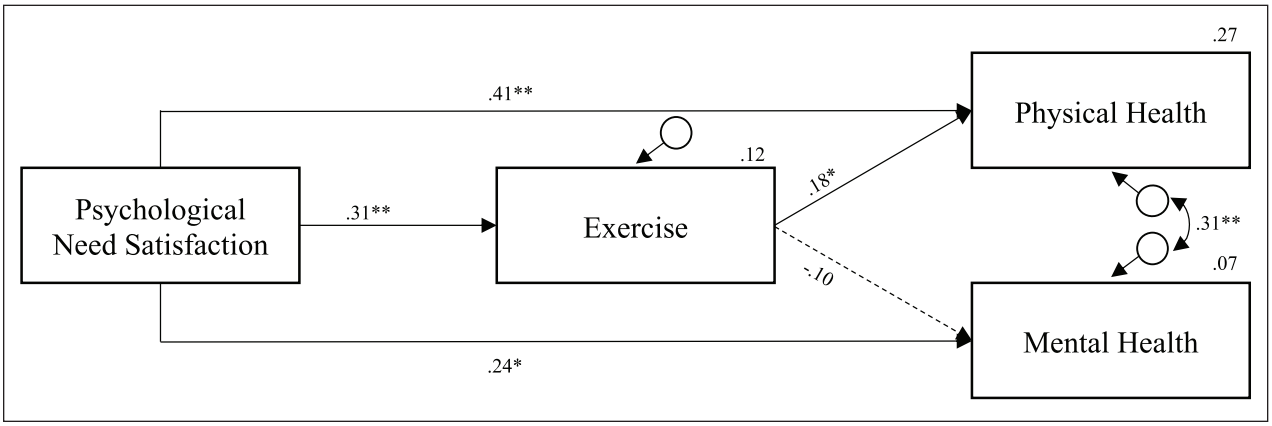

Figure 1. Results of path analysis for hypothesized model.
Note. Covariates included in the model included age, cancer stage, and time since cancer diagnosis. Variance explained in the endogenous variables is reported above the top right hand corner of the observed variables. Regression coefficients are the mean from the bootstrapping procedure ($k = 5000$). *$p < .05$. **$p < .001$.

between psychological needs satisfaction and physical health (β = .06, CI = .01 to .14). Consistent with the bivariate correlations, the path from exercise to self-rated mental health was not significant. Direct effects from psychological need satisfaction to self-rated physical health (β = .41, CI = .27 to .61) and self-rated mental health (β = .24, CI = .04 to .44) were both significant. Of the covariates included in the model, time since cancer diagnosis was a positive correlate of physical health (β = .002, CI = .00 to .01), but no other associations emerged. Overall, the final model predicted 27% of the variance in self-rated physical health and 7% in self-rated mental health.

These results indicate that satisfaction of psychological needs is indirectly associated with self-rated physical health via exercise and is directly associated with exercise, self-rated physical health, and self-rated mental health among testicular cancer survivors. Furthermore, greater exercise engagement is associated with increased physical health, but not mental health, in testicular cancer survivors.

Discussion

This study explored the relationship between psychological need satisfaction, exercise behavior and self-rated physical and mental health among testicular cancer survivors. Results generally support our hypotheses, where psychological need satisfaction was directly associated with self-rated physical and mental health, as well as indirectly associated with physical health through exercise behavior. However, exercise was not a mediator in the relationship between needs satisfaction and self-rated mental health. Findings from this study support

theoretical tenets that satisfaction of psychological needs in a given domain has the potential to infer greater perception of global health and wellness (Ryan & Deci, 2002).

Advancements in treatment protocols for testicular cancer have resulted in a growing population of survivors living well into old age. The cost of cure in this population includes a plethora of physical and mental health challenges, many of which may be mitigated by exercise (Barr et al., 2016; Fosså et al., 2018). While the majority of cancer survivors are not meeting recommended exercise guidelines for optimal health (Mason et al., 2013; Murnane et al., 2015; Sabiston & Brunet, 2012), findings from this study support previous reports identifying testicular cancer survivors as an active subpopulation of cancer survivors (Abu Zaid et al., 2016; Thorsen et al., 2003). For example, as low as 34% of breast cancer survivors are not meeting guidelines following treatment yet (Mason et al., 2013), in the present study, 66% of men meet guidelines for exercise after cancer. With this in mind, and the positive associations between exercise and physical health observed in the current study, an opportunity may exist to leverage apparent engagement and interest in exercise to mitigate acute and late effects of the disease and its treatments and improve domains of health-related quality of life.

Nonetheless, and contrary to our hypothesis, no association was identified between exercise and mental health. Further research is needed given the well-documented positive benefits of exercise on mental health outcomes in the general population and among cancer survivors in general (Bourke et al., 2016; Chekroud et al., 2018; Mack et al., 2013; Mikkelsen et al., 2017; Mutrie et al., 2007; Zhao et al., 2013). Self-rated mental health has been associated with multi-item measures of mental health and considered useful for assessing general mental health (Ahmad et al., 2014; Mawani & Gilmour, 2010). The lack of association between exercise and self-rated mental health may be due to the type and condition by which these men are engaging in exercise, which was not captured in this study. For example, it may be that group sport participation may provide greater opportunity for men to derive mental health benefits (Bruun et al., 2014; Mason & Holt, 2012; Pringle, 2009). It is not clear from the current study what type of exercise, or more broadly physical activity, may be linked to physical and mental health. Future research should aim to better understand the type of exercise and sport testicular cancer survivors' prefer to engage in to better tailor supportive care interventions that may look to leverage existing interests.

While exercise was not related to self-rated mental health, the satisfaction of the psychological needs was positively associated with exercise and self-rated physical and mental health. This finding is consistent with theoretical tenets, suggesting that all three psychological needs contribute to the prediction of exercise, which then mediates the relationship between psychological needs fulfillment and outcomes of health and wellness (Ryan & Deci, 2002; Vansteenkiste et al., 2010). Consistent with our findings, the relationship between needs satisfaction and exercise has been well established in the context of cancer survivorship (Milne et al., 2008; Peddle et al., 2008). Researchers have also documented the positive effects of need satisfaction on outcomes of mental health among cancer survivors, which is consistent with the significant, direct effect between psychological need satisfaction and self-rated mental health in this study (Mack et al., 2013). Previous research exploring need satisfaction and physical health outcomes have primarily focused on general adult populations (González et al., 2016). Therefore, the direct association between psychological need satisfaction and self-rated physical health may be a unique finding among cancer survivors and highlights an area for future exploration. Ongoing fulfillment of needs are thought to be integral in overall health (Mack et al., 2013; Ryan & Deci, 2002). Thus, future research should aim to test ways of facilitating needs fulfilment after cancer with the global aim of improving survivors' health and wellness. Furthermore, exploring additional mechanisms (e.g., positive and negative affect) that may help to explain the relationship between psychological needs and self-rated physical and mental health is a worthwhile avenue of future research.

Based on these preliminary findings, interventions aimed at supporting testicular cancer survivors' physical and mental health following diagnosis may benefit from leveraging exercise as a platform for need satisfaction. Exercise-based survivorship interventions may also increase accessibility and acceptability in this population, who historically have been underrepresented in research and usual care programming (Bruun et al., 2014). An important next step in this line of enquiry is therefore to understand how a physical activity context could improve individual domains of health-related quality of life and overall self-rated health.

Limitations and Future Research

This study has notable limitations. First, all data used in this study were collected using self-report questionnaires which include response and common method bias. Future research should consider utilizing objective measures of exercise, physical health (including comorbidities and other health concerns), and mental health. Secondly, this study used convenience sampling methods, whereby testicular cancer survivors were recruited

at one urban cancer centre in Canada, which limits the generalizability of our findings. Future research should include probability sampling methods targeting multiple sites across rural and urban settings to better understand testicular cancer survivors' experience more broadly. Lastly, data were cross-sectional which inhibits our ability to infer causality and therefore results presented and conclusions drawn represent patterns of association, not causal relationships. Of note, this study elected to draw from self-determination theory concerning direction of effects, but it is possible that a reciprocal association may exist such that men may exercise as a way of satisfying psychological needs (Curran et al., 2016). Therefore, future research is warranted to explore these associations with longitudinal data in order to test potential reciprocal associations between exercise behavior and psychological need satisfaction and in relation to physical and mental health.

Conclusion

In conclusion, our results show that psychological need satisfaction is positively associated with perceived physical and mental health following a diagnosis of testicular cancer and this relationship was partially mediated by exercise. The majority of testicular cancer survivors surveyed in this sample were meeting recommended guidelines for exercise, confirming previous reports that these men are an active subpopulation of cancer survivors (Abu Zaid et al., 2016; Thorsen et al., 2003). Findings from this study also provide preliminary support for the use of basic psychological needs theory as a framework for developing supportive care for these young men following a diagnosis of cancer. Further exploration of exercise-based interventions that support the satisfaction of psychological needs is warranted to promote optimal physical and mental health of testicular cancer survivors across the lifespan.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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