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Predictors of physical activity and quality of life in New Zealand prostate cancer survivors undergoing androgen-deprivation therapy

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Abstract

Aims The aims of this study were to: quantify the levels and predictors of physical activity in prostate cancer survivors on androgen-deprivation therapy (ADT); gain some insight into the effect of physical activity on the quality of life of prostate cancer survivors on ADT; and compare the quality of life of prostate cancer survivors on ADT with matched controls.

Methods A sample of 84 prostate cancer survivors on ADT were recruited from a register held by the Auckland District Health Board. Participants were mailed a collection of self-report surveys probing quality of life, physical activity and determinants of physical activity.

Result Less than half the prostate cancer sample were categorised as physically active, and there was no relationship between physical activity and age, PSA levels, or time on ADT. Compared to a matched control group the sample had lower scores for global quality of life, as well as on the physical and environmental quality of life domains. Results also showed that those prostate cancer survivors classified as active had higher levels of quality of life on average than those classified as insufficiently active. Attitude towards physical activity was the dominant predictor of the intention to be physically active, while perceived behavioural control was the dominant predictor of actual behaviour.

Conclusions Our findings describe a positive relationship between physical activity and quality of life in men with prostate cancer currently undergoing ADT. However, only half the sample was physically active, indicating that physical activity interventions aimed at prostate cancer survivors are of utility. Our data suggests targeting both attitudes and factors related to the ability to perform physical activity will be fruitful approaches.

Prostate cancer (PCa) is the most common cancer affecting men in New Zealand, with the incidence rates rivalling that of breast cancer for women.[1]

Many PCa survivors undergo androgen-deprivation therapy (ADT) as it slows down the progression of the disease and increases survival rates by reducing testosterone production.[2] This reduction in testosterone causes many side-effects. It directly results in a significant loss of muscle and bone mass and a gain in fat mass,[2,3] which appears to be a major determinant of the significant losses in muscular strength and endurance as well as functional capacity in tasks like sit to stand, stair climbing and fast walking.[4–6]

As a result of these (and possibly other) physiological and psychological changes, PCa survivors on ADT also report significant increases in fatigue and decreases in quality of life (QOL).[2,7,8]

Several cross-sectional studies have shown a link between physical activity and QOL in PCa survivors.[9,10] For example, PCa survivors who were more physically active had greater health-related QOL[9] and lower levels of fatigue[10] than their less-active PCa peers.

Recent reviews suggest that physical activity comprising strength, aerobic or combined strength and aerobic training can reduce fatigue as well as improve health and QOL (e.g. psychological, social and sexual), muscular strength and aerobic fitness in PCa survivors, with the magnitude of most of these changes of clinical significance.[11,12]

It has also been reported that physical activity can reduce PSA levels, meaning that the PCa survivors could avoid or delay conventional treatments such as ADT for a period of two years.[13,14]

The American Cancer Society recommends that cancer survivors would improve their overall health if they were to perform ≥150 minutes of moderate-strenuous intensity physical activity per week, of which ≥60 minutes should be strenuous.[15]

A recent review of the literature, however, suggests that many PCa survivors are insufficiently active, with some of the reviewed studies reporting physical activity rates of only 29–30%.[16] In order to increase the physical activity levels to generate health benefits, the determinants of physical activity in PCa survivors on ADT need to be understood. Currently little information is available on the physical activity patterns of PCa survivors on ADT, particularly within New Zealand.

This exploratory cross-sectional study will collect this information and will also utilise the Theory of Planned Behaviour (TPB) model[17, 18] to assess PCa survivors' attitudes about physical activity, subjective norm and self-efficacy. Finally, measures of health quality of life will be taken using the New Zealand version of the World Health Organization WHOQOL-BREF[35] questionnaire; with this QOL data compared to those of an age-matched sample from the general population.

Research design and methods

This cross-sectional survey-based study involved a convenience sample recruited using the PCa survivor register held by the Auckland District Health Board's (ADHB) Urology Department. Initially, a cover letter was sent out explaining the study and how they could participate. One week later, a series of questionnaires, an information sheet, and a stamped return-addressed envelope were mailed to 205 potential participants currently diagnosed with PCa and undergoing ADT.

Two weeks following the initial distribution of surveys, another letter was dispatched thanking those who had responded and encouraging those who had not returned the questionnaires to do so. Concurrently, normative data were collected from age- and gender-matched individuals to afford comparison with a healthy sample.

Participants—From the initial 205 questionnaires posted to potential participants, 84 replies were received, yielding a 41% response rate. The mean age of participants was 78.4 years (SD=8.21), and 70 (84%) identified themselves as New Zealand European. Fifty-two participants reported recent PSA levels (M=9.94 ng/mL, SD=22.76, Min=0.05, Max=130), and the mean time elapsed since undertaking ADT was 3.9 years (SD=3.6).

A second convenience sample from 26 organisations, including senior citizens clubs and retirement villages, was undertaken to provide comparative QOL data. From these organisations, 362 valid surveys were completed and returned, 82 of which provided a balanced sample of age, gender and ethnically matched but healthy individuals.

Measures—A self-report questionnaire asking about QOL, physical activity, and factors related to physical activity was utilised. QOL was assessed using the brief version of the World Health Organization's Quality of Life (WHOQOL-BREF) scale.[19] This scale consists of physical (7 items), psychological (6 items), social (3 items), and environmental (8 items) domains, and two general items probing global quality of life and self-assessed health.

Physical activity was gauged using the Rapid Assessment of Physical Activity Scale (RAPA), a nine-item scale (each question requiring a Yes/No response) designed to assess levels of physical activity among adults older than 50 years.[20]

The nine questions of the RAPA cover a range of physical activity levels, from sedentary to active, as well as strength training and flexibility. The responses to the nine items allows the RAPA to classify participants into one of five activity groups:

- Sedentary—"I rarely or never do any physical activities;";
- Under-active—"I do some light or moderate physical activities, but not every week;";
- Under-active regular—light activities—"I do some light physical activity every week;"
- Under-active regular—"I do moderate physical activities every week, but less than 30 minutes a day or five days a week" or "I do vigorous physical activities every week, but less than 20 minutes a day or three days a week,"; and
- Active—" I do 30 minutes or more of moderate physical activities, five or more days a week.". The first four groups are then collapsed to produce an "insufficiently active" category, while the fifth is the "active" category.

Factors influencing physical activity were assessed using a pre-existing 47-item inventory probing intention to be physically active, perceived control of factors that prevent or encourage physical activity, attitudes towards physical activity, and pressures from significant others to be physically active or not.[17, 18] Additionally, demographic items elicited information about the participant's age and ethnicity, their time on ADT, length of PCa diagnosis, and if known, the most recently assessed PSA levels.

Statistical analyses—Data analyses were conducted in SPSS v17 software. Because of the modest sample size (n=84), a thorough screen was undertaken to ensure that the data adhered to the assumptions stipulated by the respective tests, and nonparametric alternatives were employed when assumptions were violated. Prior to constructing composite measures, item mean and standard deviations were calculated to identify any floor or ceiling effects, corrected item-total correlations were scrutinised to ensure the unidimensionality of item sets, and then Cronbach's alpha computed to assess internal consistency.

Group differences in QOL domains were assessed using independent samples t-tests or Mann Whitney U-Tests. The Theory of Planned Behaviour (TPB) was applied to investigate the relationship between behavioural intention and a linear combination of the following composite variables: attitudes to physical activity, pressure from others to partake (or not) in physical activity (subjective norm), and perceived behavioural control (PBC) in relation to undertaking physical activity. In its standard form, the TPB is represented by the following equality:

$$\text{Behavioural Intention} = (W_1)\text{ATTITUDE} + (W_2)\text{SUBJECTIVE NORM} + (W_3)\text{PBC}$$

where W_i are empirically derived weights. The TPB was assessed using a multiple linear regression analysis, with standardised beta coefficients (β) examined to gauge the predictive utility of each component. The association between the three components of the TPB and actual physical activity as defined by the RAPA (i.e. active vs. insufficiently active) was determined using a binary logistic regression.

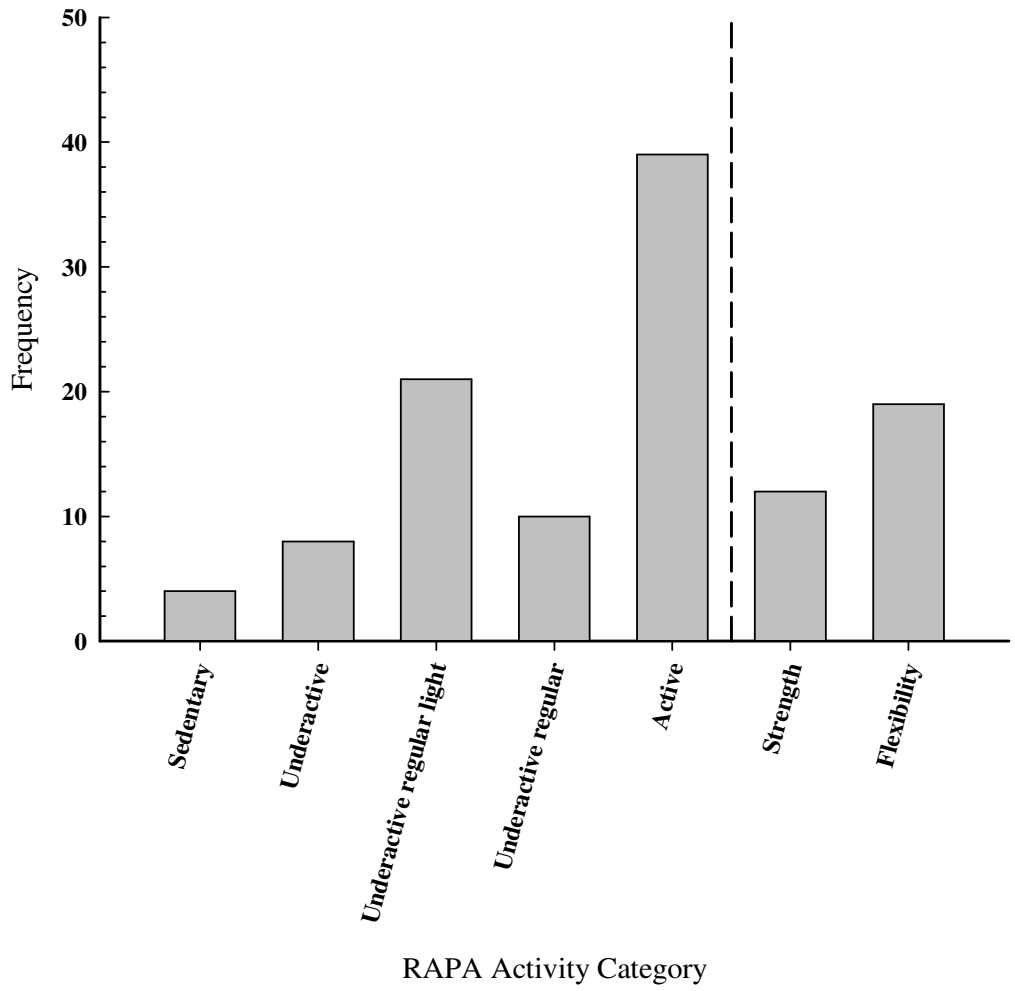
In both regression analyses covariates were not included due to sample size limitations. However, the lack of correlation between potential covariates (e.g. age, time on ADT, PSA level) and the components of the TPB meant any exclusion was likely only to reduce the overall predictive accuracy of the models rather than introduce specification errors.

Results

Levels of physical activity—Physical activity levels, shown in Figure 1, indicate that 45% of participants (*n*=38) lead an active lifestyle, while the remainder (n=46) were insufficiently active. Correlation coefficients (r) indicated a lack of association between physical activity level and either age (r=0.106, p=0.343), time since diagnosis (r=0.141, p=0.252), time on ADT (r=-0.081, p=0.470), or PSA level (r=0.118, p=0.382).

Twelve participants (14%) responded yes to the question "I do activities to increase muscle strength, such as lifting weights or callisthenics, once a week or more.", and 19 participants (23%) responded yes to "I do activities to improve flexibility, such as stretching or yoga, once a week or more."

Figure 1. The left portion of the figure shows the number of individuals falling into the five physical activity categories specified by the RAPA scale. The right portion shows those undertaking activities improving strength or flexibility



Differences in QOL—PCa survivors had significantly lower mean physical ($p<0.001$) and environmental ($p=0.025$) QOL scores than the matched sample. Furthermore, mean ratings of global QOL ($p<.001$) and self-assessed health status ($p<.001$) were also lower than the matched sample.

When PCa survivors were sorted into active and insufficiently active groups, the active group had higher mean physical QOL ($p=0.034$), global QOL ($p=0.023$), and self-assessed health ($p=0.037$). An additional series of Mann-Whitney U-tests were undertaken to assess group differences between those who reported engaging in strength training (n=12) and those who did not (n=72), and those engaging in flexibility activities (n=19) and those who were not (n=65).

Those undertaking some form of strength training had significantly higher global ($p=0.039$) and environmental ($p=0.023$) QOL than those not reporting such activities. Those partaking in activities designed to improve flexibility had significantly higher global ($p=0.006$), physical ($p=0.018$) and environmental ($p=0.008$) QOL. Note that, for any of the difference tests performed between groups, there were no significant differences recorded between mean QOL scores on the psychological or social domains ($p>0.05$).

Predictors of physical activity—Table 1 shows the results from a multiple linear regression, which indicates the association between the intention to exercise and the three components of the Theory of Planned Behaviour. Of remark in Table 1 is the strong link between attitudes towards physical activity and the intention to be physically active ($p<0.001$). Societal and peer pressures (i.e. subjective norm), and perceptions of efficacy to undertake activity (i.e. PBC), do not appear to be significantly associated with the intention to partake in physical activity.

Table 1. Estimates of unstandardised and standardised coefficients for a multiple linear regression of intention to partake in physical activity

Variables	*B*	Std Error	*β*	*t*
Constant	-1.385	2.149	–	-0.645(p=0.521)
Attitude	0.322	0.047	0.781	6.814 (p<0.001)
Subjective Norm	0.075	0.063	0.115	1.179 (p=0.242)
PBC	-.142	0.142	-.113	-0.999 (p=0.321)

Note: R=0.775; R^2=0.601, adj-R^2=0.585; SE_{est}=4.893

Predictors of actual physical activity—Table 2 displays the results of a binary logistic regression, where positive values of the regression coefficient *B* indicate that the predicted odds increase as the predictor value increases (i.e. more likely to be in the physically active group). Scrutiny of the Wald chi-square statistics in Table 2 indicates that attitude and subjective norm are not significant predictors of physical activity category.

The PBC component of the TPB emerges as a significant predictor of physical activity ($p=0.015$), indicating that the odds of being in the active group is positively related to PBC. Goodness-of-fit tests (Hosmer-Lemeshow) suggested an adequate fit

to the data. The improvement of the model displayed in Table 2 over a baseline model (i.e. one containing none of the predictors) is evident in the classification table displayed in Table 3, which indicates the agreement between predicted and actual outcomes.

Table 2. Logistic regression analysis of prostate cancer survivor's activity levels. The table displays maximum likelihood parameter estimates, both in raw form as logits (i.e. *B*) and as odds ratios (e^b), accompanied by 95% confidence intervals

Variables	*B*	Std Error B	*Wald* χ^2	e^b	95%CI for e^b
Constant	-4.796	1.34	0.02 (p<.001)	0.008	–
Attitude	0.003	0.022	0.02 (p=0.886)	0.997	0.955–1.041
Subjective Norm	0.038	0.031	1.445 (p=0.228)	1.038	0.977–1.104
PBC	0.178	0.073	5.881 (p=0.015)	1.196	1.035–1.391

Note: Cox & Snell R^2=0.242. Nagelkerke R^2=0.323. Hosmer and Lemeshow test: $\chi^2(8)$=9.41, p=0.309.

Table 3. Observed and predicted frequencies for physical activity/inactivity by logistic regression with a cut-off of 0.50. Parentheses contain the predictions from the baseline (i.e. intercept-only) model

	Predicted		
Observed	Active	Inactive	% Correct
Active	23 (0)	14 (37)	62.2 (100)
Inactive	6 (0)	39 (45)	86.7 (0)
		Overall % correct:	75.6 (54.9)

Note: Sensitivity = 62.1%. Specificity = 86.6%. False positive = 20.1%. False Negative = 26.4%.

Barriers to physical activity—Responses to open-ended questions provided insight into additional preventative and supportive factors influencing participants' physical activity. Of the preventative factors, lack of energy and health problems additional to PCa were the most common factors that prevented participants from being physically active, as well as weather and interference by paid employment. The most common factors that supported participants in being physically active were the health and mental health benefits, and the enjoyment of participating in activities that had physical components to them (e.g. gardening and household tasks).

Discussion

The majority of PCa survivors in our sample were classified as insufficiently active, with just 45% meeting the recommended guidelines set out by the American Cancer Society of at least 30 minutes of moderate intensity physical activity on five or more days per week.[15]

These results appears to lie within the extremes reported in a recent review of the physical activity levels of PCa survivors.[16] Additionally, we found no relationship

between physical activity level and time since diagnosis, PSA levels, or time on ADT. This finding has consequences in relation to timing of interventions based on physical activity, and suggests no critical time window exists immediately after diagnosis or ADT onset.

Beyond the direct physical changes, ADT has also been shown to cause very substantial reductions in QOL for PCa survivors.[8] In our sample we found PCa survivors had significantly lower physical and environmental QOL when compared to age-matched healthy individuals. Whether this constitutes evidence that the cancer or the cancer treatment may be affecting the physical domain is unclear, as 64% of respondents also reported other conditions. However, it can be argued that either a single disease or a combination of diseases would have the potential to degrade physical QOL.

Additionally, PCa survivors also had significantly lower global QOL and self-assessed health than the matched sample, echoing previous research.[7,8] Physical activity has positive benefits on QOL,[9,10] and a comparison between PCa survivors classified as active and those classified as insufficiently active supports this relationship.

On average those PCa survivors classified as active had significantly higher global and physical QOL, and higher self-rated health than insufficiently active survivors, suggesting that efforts to maintain or increase physical activity levels in this group are a worthwhile objective. Furthermore, 12 (14%) participants reported regularly partaking in strength training. This finding concurs with a recent review that suggests prevalence rates of 10–15% for strength training in older adults.[21]

While there are likely many factors contributing to the low rates of strength training in older adults (including PCa survivors), Winnett et al.[21] argue that the primary factors may be public health policy not emphasising strength training, misinformation, and the lack of theoretically driven approaches to maintain adherence in the long-term. Such views appear somewhat consistent with the predictors of physical activity found in this study along with studies on the factors associated with the use of complementary therapies by cancer survivors.[22–24]

These studies indicate that the misinformation regarding exercise often comes from potentially unreliable sources such as family, friends and the media,[22] even though exercise counselling[23] and the support of clinicians may play an important role in cancer survivors adopting and maintaining healthy behaviours such as exercise.[24]

In light of the way that cancer survivors obtain information about the benefits of physical activity and other complementary therapies and our findings indicating that most PCa survivors are insufficiently active, considerably more effort needs to be focused on ensuring that a greater proportion of PCa survivors especially those on ADT are physically active. Such results would suggest that clinicians working with PCa survivor are in a unique place to offer such advice.

Intention to engage in physical activity is driven by a number of factors, including attitude, subjective norms and PBC. Two studies of PCa survivors using the TPB[25,26] report that these three factors explain a high percentage of the variance in physical activity intention.

Consistent with these previous studies,[25,26] the best predictor of physical activity in the present dataset was the PBC. The PBC component combines the notions of perceived control and self-efficacy in relation to a behaviour, where perceived control is an assessment of external constraints and self-efficacy the belief that one has the ability to perform certain behaviours.

Our participants identified a range of factors that both prevented and supported them in being physically active, with health problems and disability being the highest preventative factor. Additionally, lack of energy was the most highly reported factor that prevented participants from engaging in physical activity. This was expected, as fatigue is a debilitating side-effect of both cancer and cancer treatment, including ADT.[2,10]

Such a result is a sort of vicious cycle, whereby if a PCa survivor is tired, they won't exercise, and if they don't exercise, they will be more tired. However, as increasing physical activity can actually reduce fatigue in PCa survivors,[27] this further demonstrates the importance of exercise counselling for these individuals.

Limitations and future research—Small convenience samples increase the probability of type I errors by preventing the use of more sophisticated multivariate techniques, and also invite type II errors by providing less than satisfactory power. However, while the findings we report here may be considered somewhat speculative and need to be confirmed with a larger New Zealand sample, they are congruent with findings reported overseas.[7,16,26]

A second limitation is the use of self-report inventories, with participants potentially overstating their levels of physical activity and under-reporting sedentary behaviours due to social desirability bias.[28] Furthermore, while the PCa group differed to the matched group on the basis of the cancer diagnosis and use of ADT, no attempt was made to match the groups on the basis of self-reported health or comorbidities.

It is therefore not entirely clear how the cancer, use of ADT, health status or comorbidities contributed to the findings of this study. Future research may address this question by comparing various sub-groups of PCa survivors to determine the effect of treatment type, health status or comorbidities on physical activity, QOL and their inter-relationships. Randomised controlled trials should also be conducted to examine the effect that exercise counselling has on the adoption and maintenance of physical activity levels in PCa survivors, and how these potential changes in physical activity may be associated with improved QOL and reduced fatigue.

Competing interests: None.

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